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A Preliminary Summary of
Progress and Plans //

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3^o FOOD AND NUTRITION, TEXTILES AND CLOTHING, HOUSING AND
HOUSEHOLD EQUIPMENT AND FAMILY ECONOMICS RESEARCH

of the United States Department of Agriculture
and

in cooperation with
State Agricultural Experiment Stations ; +3a

Prepared for the Department's
FOOD AND NUTRITION RESEARCH ADVISORY COMMITTEE

for its 11th Meeting
Washington, D. C
October 31 - November 2, 1960

and for the Department's
HOME ECONOMICS RESEARCH ADVISORY COMMITTEE

U. S. DEPT. OF AGRICULTURE
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for its 7th Meeting
Washington, D.C
December 7-9, 1960

SEP 9 - 1964

C & R-PREP.

This progress report is primarily a tool for use by advisory committee members in developing recommendations for present and future research programs and by USDA administrators for developing, coordinating, and evaluating research plans. Included in it are summaries of research done during the past year. Some are tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to advisory committee members, research administrators, and others having special interest in the development of public agricultural research programs.

The report also lists publications of research results issued during the year. Current agricultural research findings are also reported in the monthly USDA publications, "Agricultural Research" and "Agricultural Marketing."

UNITED STATES DEPARTMENT OF AGRICULTURE //
Washington, D. C.

FUNCTIONS OF ADVISORY COMMITTEES

The Food and Nutrition and Home Economics Committees are two of twenty-four commodity and functional committees of the U. S. Department of Agriculture established pursuant to Title III of the Research and Marketing Act of 1946. Functions of the members of these committees include:

1. Acquainting themselves with the problems of producers, processors, distributors, and consumers, and presenting them for committee consideration.
2. Reviewing the current research and marketing service programs of the Department and recommending adjustments, including terminations, in the current program in order that available funds, personnel and facilities will be used on problems of greatest importance.
3. Recommending new work or expansion of current work and indicating relative priority of such recommendations, when the current program is insufficient to develop solutions for important problems.
4. Developing a better understanding of the nature and value of the agricultural research program, explaining it to interested groups and organizations and encouraging the wider and more rapid application of the findings of research.

The committees perform an important function in advising with respect to the development of the Department's research and marketing service programs. However, committee members recognize that the development of budgets and the implementation and administration of research and marketing programs are responsibilities of the Department.

A progress report similar to this one is prepared for each of the other twenty-two committees which are:

Citrus and Subtropical Fruit	Oilseeds and Peanut
Cotton and Cottonseed	Potato
Dairy	Poultry
Deciduous Fruit and Tree Nut	Refrigerated and Frozen Products
Economics	Rice
Farm Equipment and Structures	Sheep and Wool
Forage, Feed and Seed	Soils, Water and Fertilizer
Food Distribution	Sugar
Forestry	Tobacco
Grain	Transportation
Livestock	Vegetable

This progress report was compiled by Robert E. Stevenson, executive secretary, Food and Nutrition and Home Economics Research Advisory Committees, Office of Administrator, Agricultural Research Service, U. S. Department of Agriculture, Washington 25, D. C.

CODES TO DESIGNATE UNITS CONDUCTING RESEARCH

AGRICULTURAL RESEARCH SERVICE (ARS)

Farm Research Divisions

AE	Agricultural Engineering
ADP	Animal Disease and Parasite
AH	Animal Husbandry
CR	Crops
ENT	Entomology
FE	Farm Economics
SWC	Soil and Water Conservation

Utilization Research and Development Divisions

EU	Eastern
NU	Northern
SU	Southern
WU	Western

Home Economics Research Divisions

CH	Clothing and Housing
HHE	Household Economics
HN	Human Nutrition

AGRICULTURAL MARKETING SERVICE (AMS)

Marketing Research Divisions

MD	Market Development
ME	Marketing Economics
MQ	Market Quality
TF	Transportation and Facilities
	Agricultural Economics and Statistics Divisions
AEc	Agricultural Economics
AEs	Agricultural Estimates

FCS FARMER COOPERATIVE SERVICE

FAS FOREIGN AGRICULTURAL SERVICE

FOREST SERVICE (FS)

Forest Research Divisions

FDR	Forest Disease
FER	Forest Economics
FFR	Forest Fire
FIR	Forest Insect
FPR	Forest Products Utilization
RMR	Range Management and Wildlife Habitat
WMR	Watershed Management

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I. HUMAN NUTRITION

A. MULTIPLE NUTRIENT STUDIES OF HUMAN METABOLISM

HN

Problem: Both scientific progress and research economy require multiple nutrient analyses in studies of human metabolism wherever feasible, especially when ordinary diets of known composition are used. Parallel analyses of intake and output of many different nutrients, as measures of metabolic response to diet, would make full use of expensive metabolic materials and permit analysis of interactions of nutrients as well as more adequate comparison, evaluation, and interpretations of data.

Program: Work is being continued on two types of multiple-nutrient studies of human metabolism: (1) Response to mixed diet of ordinary foods, and (2) response to standardized diet of partially purified foods and regulated intakes of specific nutrients. Approximately 3 professional federal man years annually are involved in work at Beltsville, plus contract research at four locations.

Progress:

Metabolic Studies With Preadolescent Children. Major contributions to our understanding of the metabolic behavior of children and knowledge of human nutritional requirements have come from five years of cooperative research with the Southern Region. Data on the metabolic responses of 36 healthy preadolescent girls to a controlled diet of ordinary foods began to be released during 1960. One bulletin describing the methods was published by the Virginia Agricultural Experiment Station, and seven technical papers, three of them by USDA staff, were presented at national scientific meetings in April. A resume of the findings on nitrogen retention was presented by request at the Fifth International Congress on Nutrition in September 1960 (7, 11, 12).

This study of 7- to 9-year old girls affords metabolic data on more individuals and simultaneously on many more nutrients than have ever before been obtained in any laboratory for any age group. The data represent analyses for a total of 59 metabolic periods of 4 to 6 days each or 2240 person-days. Analyses of intake and outgo or of content in blood serum have been made for some 30 nutrients including minerals, vitamins, nitrogen, and amino acids. Results show, for example, that under the most favorable dietary conditions, 22 grams of protein and 2200 calories daily can meet average minimum requirements of this age group. The level and kind of protein fed was found to affect not only nitrogen retention for growth, but also the utilization and retention of calories and a surprising number of minerals and B-vitamins. The initial metabolic response of the children differed widely but adjusted itself for most nutrients after two or three weeks on the controlled diet to fairly uniform patterns which appeared to be characteristic for the nutrient.

Plans: Data from the five-year studies of preadolescent girls are being prepared for publication by the different cooperators. Analyses of data are being continued on the metabolic response of young women to a reference diet reported last year, and a cooperative publication of these data is in preparation.

B. FATS AND FATTY ACIDS IN NUTRITION

HN

Problem: The complex nature of the problems of fat in nutrition has only recently begun to be appreciated. Better understanding of the role of fat in nutrition is needed along many lines, especially with regard to the influence of other nutrients on fat metabolism and vice versa.

Program: Studies using laboratory animals fed different kinds and amounts of fat in ordinary diets and in diets characterized by excesses or deficiencies of other nutrients are being continued to define short-term and long-term effects, to discover trends in metabolic response, and to give guidance to necessarily limited studies using human subjects. This research requires about 10 professional federal man years annually at Beltsville. Studies in human metabolism of fats also are under way at six locations under contract arrangements.

Progress:

1. Vitamin B₆ and Fat. The relation of vitamin B₆ to fat metabolism is being determined under controlled dietary conditions using the laboratory rat as experimental animal. Studies of reproductive performance and body composition of vitamin B₆-fed and of vitamin B₆-deficient female rats receiving 15 percent corn oil or 15 percent hydrogenated shortening have provided evidence that the kind of dietary fat may influence the physiological response to a vitamin B₆ deficiency. Deficient animals when fed either fat produced fewer and lighter off-spring than did the control animals receiving B₆, but deficient animals fed hydrogenated shortening produced fewer than half as many live young as did those fed corn oil. Carcass and liver fat were reduced in deficient mothers and carcass fat in the young of deficient mothers was slightly lower than in those of controls, but the kind of dietary fat did not influence fat content. Serum cholesterol levels were lower in all animals fed the hydrogenated shortening than in those receiving corn oil. The lowest cholesterol levels observed were in the vitamin B₆-deficient group fed the hydrogenated shortening (1).
2. Lipid Metabolism in Young Men. In a coordinated study of multiple-nutrient metabolism by 19 young men at three universities, lipids in blood serum as well as intake and outgo of nitrogen, fat, and several minerals were determined. The basic dietary fat was fed at 38 percent of the calories and was a blend of fats and oils representing the kinds and proportions in this country's average consumption. The basic blend was also modified with safflower oil to give higher levels of linoleic acid. In two locations, levels of 10, 20, and 30 percent linoleic acid in the fat were fed for 15 days each; in another location 10 and 25 percent for 25 days each. Three papers reporting some of the results were presented at a national meeting in April (14, 15, 16).

In general, initial serum cholesterol levels on self-selected diets were highest in the state of Washington, lowest in Arkansas, intermediate in Alabama. Individuals having highest initial cholesterol levels responded more slowly as linoleic acid intake was increased, than did those with low initial blood cholesterol. At each location two-thirds or more of the men showed some lowering of serum cholesterol as compared with the level observed on self-chosen diet. However, a few showed some elevation of serum cholesterol in going from their self-chosen diets to the controlled diet containing 10 percent linoleic acid. The percentage of dienoic acid in the phospholipids, cholesterol ester, and glyceride fractions in the serum tended to increase with dietary linoleic acid. The amount of total fat excreted was not changed much by the level of dietary linoleic acid, but magnesium output increased as dietary linoleic acid increased in most cases resulting in more or less marked negative balances.

A fourth metabolic study of 6 young men is underway to determine the metabolic response to two types of dietary carbohydrate and to compare the effects on blood lipid levels as well as nitrogen and mineral metabolism.

Plans: Data on lipid metabolism in young men in 4 studies under contract will be prepared for publication. Studies are being continued on response of rats to various combinations of protein, fat, and carbohydrate, as measured by food utilization, deposition of body fat, blood lipids, histological and other pertinent criteria.

C. PROTEIN AND AMINO ACIDS

HN

Problem: Tentative requirements for the individual "essential" amino acids have been determined for young men and young women in various laboratories, using semi-synthetic diets. Information is needed on the validity of these tentative requirements when fed as protein foods in common mixed diets, with their different assortments and levels of various essential and non-essential amino acids and total nitrogen.

Program: The Division has supported, under contract arrangements, basic research on requirements of young women for individual essential amino acids when fed in pure uncombined forms in semi-synthetic diets. Exploratory studies (three contracts) with young adults have also been carried out to determine desirable patterns of amino acid intake in comparison with the assortments found in combined forms in typical food proteins. Microbiological studies of the same foods and amino acid patterns at Beltsville involve about 2 professional federal man years annually.

Progress:

Nitrogen Balance on Selected Patterns of Amino Acids. Comparative efficiency of nitrogen utilization on selected patterns of amino acids have been investigated at three laboratories and technical reports are in various stages of preparation. The purpose was to study the nitrogen retentions of young adults when receiving amino acid assortments conforming

to the provisional pattern suggested by FAO, and to the patterns occurring in selected foods. Each pattern was fed as the natural intact food protein supplemented with amino acids to simulate the provisional pattern and also entirely as purified free amino acids. The foods studied so far are egg, oatmeal, peanut butter, and milk. Findings presented at the April 1960 meeting of the Institute of Nutrition on six young men receiving egg, are typical of those obtained for other commodities (6, 13). The nitrogen balances showed the egg pattern to be superior to those on the FAO provisional pattern, whether amino acids were supplied in the purified form, or were supplied as egg protein. Wheat flour, a second cereal food, is under study.

Plans: Results obtained in three studies under contract on amino acid patterns in 4 foods (egg, milk, peanuts, oats) will be evaluated and prepared for publication. A similar study on wheat will be continued. Parallel data from the microbiological studies of the significance of amino acid patterns will be prepared for publication.

D. CELLULAR METABOLISM

HN

Problem: Microorganisms are efficient tools for exploring many problems of nutrition and metabolism, particularly at the cellular level. Such investigations may utilize familiar microorganisms already employed in nutrient assays, or may involve search for organisms with nutrition and metabolic characteristics more like those of cells of higher animals.

Program: A small staff at Beltsville has been studying interactions of nutrients using two types of organisms. In studies with Leuconostoc mesenteroides, a lactic acid bacterium, attention has been focused on interrelationships among amino acids and between amino acids and peptides as they affect cell growth and protein synthesis. The ciliated protozoan, Tetrahymena phriformis is being used as a tool in other metabolic studies of interactions among nutrients, because of its recognized mammalian-like nutritional requirements. This work involves 2 to 4 professional federal man years annually.

Progress:

1. Carbohydrate-Nitrogen Interactions. The effect of type of carbohydrate on growth of T. pyriformis was observed in completely defined media containing the ten amino acids considered essential for normal growth of rats, plus serine, essential vitamins, minerals, purines, and pyrimidines. With carbohydrates present at levels of 1 or 2 percent, rate of growth, maximum growth attained, and size of individual cells were significantly greater in the presence of complex carbohydrates (starch, glycogen, dextrin) than in the presence of simple carbohydrates (glucose, fructose). At lower (0.25 or 0.5 percent) carbohydrate levels overall growth was limited, but there were no significant differences in relation to type of carbohydrate. Improved growth as measured by cell numbers and cell volume of T. pyriformis in dextrin compared with glucose-containing media, has been confirmed by dry weight and protein determinations. Carbohydrate analyses of

T. pyriformis cultures growing in media containing 1 or 2 percent dextrin showed that, under these conditions, reducing sugar levels of 0.25 to 0.5 percent were developed in the media during the first 20 to 30 hours of incubation and maintained during the entire period of growth. These findings suggested that growth inhibition by glucose might be interference, due to excessive intracellular carbohydrate levels, with accumulation or utilization of amino acids; and improved growth in the presence of dextrin might be due to the gradual hydrolysis of the polysaccharide so that concentrations of glucose remained below inhibitory levels. However, the differential in growth response to dextrin as compared with glucose remained relatively constant in additional experiments with amino acid concentrations varied to provide total nitrogen levels ranging from suboptimal to inhibitory. These findings do not support the explanation suggested above that glucose may inhibit amino acid accumulation or utilization. Nevertheless, a specific interaction between glucose and amino acids in the metabolism of T. pyriformis seems likely because the results of other experiments showed that glucose became increasingly inhibitory as media concentrations of amino acid nitrogen were increased (5).

2. Amino Acid Interactions. The susceptibility of the concentrative mechanism through which an amino acid is drawn into the cell, to the presence of antagonistic levels of other amino acids was examined by use of C^{14} -labeled amino acids. As a model system we chose to study first the uptake of serine by washed cells of Leuconostoc mesenteroides and the ability of threonine, glycine, and alanine to influence this uptake (4). In earlier reports, it was noted that in growth studies these three amino acids were found to inhibit the utilization of serine (3). In the presence of glucose, phosphate buffer, and a thick suspension of washed cells, DL-serine- 3-C^{14} was incorporated into a metabolic "pool", which could be extracted for study. This "pool" is similar in many respects to the so-called "free amino acid pool" which is believed to be intimately involved in protein synthesis. Testing the ability of glycine, threonine, or alanine to reduce the level of serine found there, indicated that only glycine was effective. These first results indicate, therefore, that there is a good possibility that the effect of glycine upon serine in growth studies may be the result of its ability to lower the amount of serine available to the cell.

Plans: Investigations are being continued on interrelationships among nutrients as shown by the growth and nutrition of T. pyriformis, and other selected cellular organisms.

E. REFERENCE DATA ON HUMAN NUTRITION

HN

Problem: The increasing number of channels for reporting research findings on human nutrition and metabolism, and the numerous types of clinical and laboratory investigations underway in all parts of the world, challenge researchers to keep abreast of progress in any one field of nutrition. New methods of abstracting and indexing help to locate pertinent reports, but still neglected are attempts to collate and integrate the data available as a guide to further research in a particular field.

Program: A small staff at Beltsville is assembling and integrating original metabolic data on individuals, from published and unpublished sources, for purposes of overall evaluation and, where possible, derivation of new hypotheses or modification and substantiation of existing tentative ones. The assembled data are published in sufficient detail to enable other investigators to insert new data and extend statistical analyses as conditions warrant. Two professional federal man years per year are being devoted to this work.

Progress:

1. Heights and Weights of Adults in the U.S.A. A publication has been completed during the year summarizing available data on heights and weights of adults over the last 100 years. It includes 80 reference tables and 35 charts showing trends with time and age, and the relation of body size to some environmental and hereditary factors. The bulletin contains heretofore unpublished data on persons over 18 years in some 9000 families interviewed in the 1955 survey on food consumption and on 150,000 college students. It also includes figures on heights and weights of freshman students dating back to 1860 in four of the oldest colleges for men and for women.

The summaries bring together published data on men in military services in different wars, data from other countries compared to U.S.A. and changes in the proportion of this country's population between 1790 and 1950 by country of origin of immigrants. Young adults in the U.S.A. today were found to average two inches taller than they did 60 years ago, and heights now average 69.5 inches and 64.5 inches for men and women, respectively. This bulletin is a companion to the data volume on heights and weights of children in the U.S.A. published in 1957.(10).

2. Basal Heat Production in Children. In preparation for publication are the assembled published and unpublished data on basal metabolism of children with statistical evaluations and integration as far as possible. From this summary of data, old hypotheses have been reexamined, and where possible new prediction formulae developed. The proposed publication will contain data from some 80 investigations, together with some 25 tables and as many charts.

Plans: The publication on basal metabolism of children will be completed. The few data on energy metabolism of infants, mostly under "sleep" conditions, are being summarized and analyzed separately. Metabolic data on magnesium have been assembled and are under statistical analyses for effects of age and other apparent factors.

Publications: Part I HUMAN NUTRITION

Experimental Nutrition

1. The Effect of Type of Dietary Fat on Reproductive Performance and Body Composition of the Vitamin B₆ Deficient Rat. M. L. Brown. Jour. of Nutrition 71 (3): 235-241, July 1960.

2. Effect of Dietary Fats and Carbohydrates on Digestibility of Nitrogen and Energy Supply, and on Growth, Body Composition and Serum Cholesterol of Rats. M. W. Marshall, H. E. Hildebrand, J. L. Dupont, and M. Womack. *Jour. of Nutrition* 69 (4): 371-382, Dec. 1959.
3. Effect of Peptides and Amino Acids in the Serine Nutrition of Leuconostoc mesenteroides. T. P. O'Barr and D. A. Pierce. *Jour. Bacteriol.* 79: 519-523, 1960.
4. The Effect of Alanine, Threonine, and Glycine Upon the Incorporation of Serine into Resting Cells of Leuconostoc mesenteroides. *Bacteriol. Proc.* 163: 1960. Society of American Bacteriologists, May 1960, Philadelphia, Penna.
5. Effect of Type of Carbohydrate on Growth and Nitrogen Utilization in Cultures of Tetrahymena pyriformis. H. Reynolds and J. Wragg. *Bacteriol. Proc.* 40: 1960. Society of American Bacteriologists, May 1960, Philadelphia, Penna.

Human Metabolism

6. The Effect of Sources of Nonessential Nitrogen on Nitrogen Balance in Young Adults. M. E. Swendseid, C. L. Harris, and S. G. Tuttle. *Jour. of Nutrition* 71 (1): 105-108, May 1960.
7. Metabolic Patterns in Preadolescent Children. I. Description of Metabolic Studies. So. Coop. Ser. Bul. 64, 90 pp., illus. Sept. 1959. (Prepared by the Tech. Com. of the So. Region. Nutr. Res. Proj. S-28, Human Nutr. Res. Div. cooperating.)
8. Nutritional Status...U.S.A. Compiled and edited by A. F. Morgan. Calif. Agr. Expt. Sta. Bul. 769, 131 pp., illus., Oct. 1959. (4 regions and Human Nutr. Res. Div. cooperating.)
9. Food Patterns of Washington Adolescent Children. M. M. Hard and N. C. Esselbaugh. Wash. Agr. Expt. Sta. Bul. 613, 3¹/₂ pp., illus., Feb. 1960. (West. Region. Proj., Human Nutr. Res. Div. cooperating.)
10. Heights and Weights of Adults in the United States. M. L. Hathaway and E. D. Foard. Home Econ. Res. Rept. No. 10. In press.
11. Intake and Fecal Excretion of Fat by 36 Preadolescent Girls. L. B. Stier, D. D. Taylor, P. A. Goodman, and J. K. Pace. American Institute of Nutrition, April 1960, Chicago, Illinois. (Abstract in Fed. Proc. 19 (1) Part I: 324, 1960)
12. Intake and Urinary Excretion of Folic Acid by 36 Preadolescent Girls. J. K. Pace, L. B. Stier, D. D. Taylor, and P. A. Goodman. American Institute of Nutrition, April 1960, Chicago, Illinois. (Abstract in Fed. Proc. 19 (1) Part I: 415, 1960)

13. Comparison of Essential Amino Acid Patterns. J. H. Watts, M. E. Swendseid, C. L. Harris, and S. G. Tuttle. American Institute of Nutrition, April 1960, Chicago, Illinois. (Abstract in Fed. Proc. 19 (1) Part I: 12, 1960)
14. Lipid Metabolism of Young Men in Arkansas. M. I. Irwin and H. F. Wiese. American Institute of Nutrition, April 1960, Chicago, Illinois. (Abstract in Fed. Proc. 19 (1) Part I: 225, 1960)
15. Lipid Metabolism of Young Men in Washington State. M. R. Gram, E. A. Donald and H. F. Wiese. American Institute of Nutrition, April 1960, Chicago, Illinois. (Abstract in Fed. Proc. 19 (1) Part I: 225, 1960)
16. Lipid Metabolism of Young Men in Alabama. F. L. Meyer and D. D. Taylor American Institute of Nutrition, April 1960, Chicago, Illinois. (Abstract in Fed. Proc. 19 (1) Part I: 225, 1960)

II. FOOD COMPOSITION

A. PROXIMATE COMPOSITION OF FOODS

HN

Problem: Analyses are needed of the composition of food products in new forms and improved qualities, to provide data for tables of nutritive values, and for diet appraisal and food planning -- national, household, and individual.

Program: Continuing work in food analyses is part of a broad laboratory program to up-date information about the nutritive value of foods as purchased and eaten in the USA today. The data are used in revising tables of food composition and nutritive value, in setting standards for food procurement, as for Type A school lunches, and in contributing to the development of standards for market quality of selected commodities, such as lamb, pork, convenience foods, and ready-to-use mixtures. Involves about 4 professional federal man years annually.

Progress:

1. Pork Cuts. The amount of fat in meat cuts and particularly the fat content of the lean are important to people concerned with control of dietary fat and the percentage of total calories from fat. Cuts of pork were analyzed for fat and also for a number of other nutrients. Physical yields of separable lean and separable fat were obtained and chemical analyses were performed on paired ham, loin, and shoulder cuts from 12 animals of known genetic history, predominantly Duroc and Yorkshire breeds, representing fat lines at two levels in each breed. These cuts of paired right and left sides were analyzed raw and cooked. In addition to the above three paired cuts, analyses were made on the Boston butt, spareribs, fat back, bacon and jowl square from 4 animals, two in each of the two breeds.

Proximate analyses have been completed on the separable lean and separable fat of 160 cuts from 20 animals, and the drippings of the cooked cuts. The samples of separable lean were also analyzed for their B-vitamin content -- thiamine, riboflavin, niacin, pantothenic and folic acids -- and for the mineral elements boron, phosphorus, magnesium, iron, aluminum, calcium, copper, sodium, and potassium. Eighteen amino acids were determined in selected samples of separable lean from the ham shank. Data are being tabulated and summarized prior to preparation of a manuscript for publication.

2. Convenience Foods. The increasing proportion of foods available in packaged convenient form for easy preparation for serving has brought questions about the dietary contributions of these foods as compared to similar items prepared in the home from recipe materials. Contents of packaged foods are not specified sufficiently for calculations of moisture, fat, ash, and nitrogen in the food. Therefore, a number of food items, 217 altogether, many of them being investigated under other projects for consumer quality and economy, have been analyzed for their

proximate composition. These include: (1) 115 "main dish" items, in canned and frozen forms and home prepared for comparison, representing such products as beef barbecue sandwiches, TV dinners, patties, pot pies, stews, chow mein, meat loaf, pizza pies, sausage, soups and spaghetti; (2) some 20 miscellaneous items such as doughnuts, potato chips, and potato patties and puffs; (3) 86 baked goods and dessert items received in the laboratory as dry mixes, canned, frozen, or ready-to-serve items or items prepared from convenience market forms, such as brownies and other cookies, angel, devil's food, pound, white, and yellow cakes, pies, puddings, icings, biscuits, muffins, rolls, pancakes and waffles. The data obtained are being used for interpreting factors relating to consumer economics, and should prove helpful in evaluating their dietary contributions. The data have been tabulated in preparation of manuscripts for publication. Analyses will be made on some additional items to round out comparable data on convenience foods as purchased and as served.

Plans: Much time during the next year will be given to preparation of publications reporting the original data. Analyses for proximate composition will continue in close cooperation with other projects procuring food samples for analyses for minerals, vitamins, fatty acids, and other constituents.

B. FATTY ACIDS IN FOODS

HN

Problem: Need for data on the fatty acid composition of foods continues acute from year to year. Data have been wanted by persons from many scientific disciplines, including those concerned with food processing, food planning, nutrition and clinical work. Many of the data obtained by conventional analyses are obsolete, and need to be replaced with values obtained for fatty acids analyzed individually, as by gas chromatographic procedures.

Program: For several years this Division has been assembling available data from the literature and obtaining new analyses by conventional methods, in order to expand and round out the body of information sufficiently to prepare at least some preliminary tables of fatty acids in foods. Much of the early work was accomplished through contract. Chromatographic analyses involve about 6 professional federal man years in 1960-61.

Progress: During 1960 the Division program of analyses has been expanded about three fold for systematic analyses of foods fats and oils by gas-liquid chromatography. The time required to put samples through the chromatograph columns is only a fraction of the time needed for preparation of samples, and experience has shown that samples cannot be prepared far in advance of the chromatographing. Work on the various phases, from extraction to calculation of recordings, has now been synchronized and new data are being accumulated as a basis for new tables. Collateral analyses for proximate composition are being made on all foods sampled.

Plans: Laboratory analyses using improved analytical methods will be continued at Beltsville. Subsamples of the foods procured are being held also for cholesterol and perhaps vitamin E determination as available staff time will permit.

C. VITAMINS IN FOODS

HN

Problem: Recognition of the nutritional importance of any particular vitamin or other food constituent, sparks a demand for information on sources in foods. Also, from time to time, comparable data are wanted on new foods and new forms of familiar commodities as to content of well-known vitamins.

Program: As staff time and funds permit, analytical work on newly identified vitamins is undertaken, usually after some time is spent in developing or standardizing analytical methods. Vitamins B₆ and B₁₂ are currently under investigation at Beltsville, but work in analyses for the well-known B-vitamins--thiamine, riboflavin, niacin, pantothenic acid, and folic acid--has been curtailed temporarily in order to concentrate on improvement of methods particularly pantothenic and single approach for pattern analysis of all B-vitamins. Involves about 5 professional federal man years annually.

Progress:

Vitamin B₁₂ in Foods. Two test organisms, L. leichmannii and O. malhamensis, yielded comparable data generally of the same order of magnitude as an indication of vitamin B₁₂ activity of selected foods of animal origin. Of 27 food items analyzed for vitamin B₁₂ potency, 15 were significantly higher, by an average of 13 percent, when the O. malhamensis procedure was used. This was somewhat surprising since the reported specificity of O. malhamensis for vitamin B₁₂ should exclude any extra value due to the presence of non-specific vitamin B₁₂ related substances or those presumably of deoxyriboside nature. It was concluded that the L. leichmannii procedure would be used for continuing studies of foods for vitamin B₁₂ values, especially for those not subject to bacterial activity, because the organism is better suited for routine assays.

Analyses to date show beef liver, fresh weight, as purchased, to contain 120 micrograms of vitamin B₁₂ per 100 grams of edible portion as compared to chicken liver, 23 micrograms. Relatively high values were found for oysters, 21; beef heart, 12; crabmeat, 8; canned salmon, 7. Values for muscle meats were: beef 2, lamb 1.5, pork loin 0.6, chicken (breast or thigh) 0.4. Values for cheeses averaged 1.0, and yogurt, a fermented product, lowest of all foods analyzed, 0.07. The sample of yogurt even on a dry-weight basis contained only 0.5 micrograms of vitamin B₁₂ as compared to dry skim milk with 4.4 micrograms per 100 grams. (2)

Plans: A bulletin showing distribution of vitamin B₁₂ in foods will be published; analyses on the loss of vitamin B₁₂ during cooking will be completed. Analyses will continue on the distribution of vitamin B₆ in foods. A paper on the content of B-vitamins in vegetables which were sampled geographically for mineral analyses is being prepared for publication.

D. TABLES OF FOOD COMPOSITION

HHE

Problem: Reliable food composition values are needed for appraisal of diets and food supplies and for developing educational materials to help in dietary planning and food selection.

Program: An ongoing research program involving the compilation of analytical values from the world's scientific literature, their evaluation and summarization. The resulting repository of food composition data provides information for many users not only in food and nutrition programs but in educational, marketing and regulatory programs as well. Tables of food composition are published from time to time and revised as needed to keep abreast of current knowledge of food values and new food products on the market. About 9 professional federal man years are involved annually.

Progress: A new publication "Nutritive Value of Foods" has been prepared to meet the continuing needs of the general public for up-to-date information on the composition of foods. Values are given for specified weights and household measures of over 500 commonly-used foods. Included are data for calories; protein, fat and carbohydrate; two minerals, calcium and iron; and five vitamins. In addition values are given for the total amount of saturated fatty acids and two important unsaturated fatty acids, oleic and linoleic acids. More detailed information on fats is given in this publication than in previous tables because of the current concern to physicians, dietitians and nutritionists, and the general public about the role of fat in nutrition and the kinds and amounts of fats in diets.

Many users of this publication will wish to estimate the nutritive value of their own diets or those of other individuals. For this purpose supplementary information has been included to extend and facilitate the use of the basic table. For example, meats present a somewhat special problem in that data in the publication are for specified weights of cooked meat, although often only the weight of the raw meat purchased is available; and meats may lose considerable fat and moisture during cooking. A short discussion and table to serve as a guide for estimating yield of cooked meat to be expected from raw meat as it may be purchased has therefore been included. Also, a table of the Recommended Dietary Allowances of the NAS-NRC has been reproduced in this publication for the convenience of those who wish to evaluate food consumption.

This publication will be issued in the Home and Garden Series (No. 72) to facilitate wide distribution. It will replace AIB 36, "Food Values in Common Portions," 1951, and also will serve as a replacement for the next few years of Table 3 of Agricultural Handbook No. 8, "Composition of Foods... raw, processed, prepared."

For use in machine calculation of the nutritive values of diets, data from this table have been put on to punch cards. Sets of these cards together with a manual of instructions for their use are now available to workers making dietary surveys.

In addition to published tables issued from time to time, the ongoing work in this field provides information for many research and administrative purposes. During the past year, for example, medical groups have requested information on magnesium, sodium, potassium, carbohydrate fractions, cholesterol and on fats and fatty acids in foods. Workers concerned with radiobiological aspects of defense and the safety of the food supply have needed

information on the mineral content of different milling fractions of wheat, and of various breakfast cereals as a basis for estimating the strontium-90 content of foods. Questions have come from the Quartermaster General's office concerning the yields and nutritive values for cooked foods estimated from raw. The number and scope of such requests is constantly increasing.

Plans: Completion of revised tables of food composition (Handbook 8) and preparation for printing will continue to receive major emphasis. This completely revised and greatly expanded publication will contain nutritive values for over 2,000 food items in each of 2 tables - 100 gm. Edible Portion and 1 pound As Purchased. At some future time these new values will be the basis of a revision of the former Table 3, Composition of Foods in Common Household Units. Meanwhile the ongoing work of indexing literature references and recording data will continue. The feasibility of using mechanical methods in compiling and summarizing food composition data will be investigated.

E. PROTEIN SYNTHESIS AND MINERAL INTERRELATIONSHIPS

SWC

Problem: Biochemical pathways in protein synthesis need to be determined in order to meet human nutrition needs as well as the needs for economically sustained production on farms. It is necessary to discover relationships between soils, plants and animals and one problem of great significance is to isolate the different ribonucleic acids involved in protein formation.

Program: A continuing long term program to expand fundamental knowledge of the relationship of soils to the nutritional qualities of plants and to the metabolic processes in animals and man consuming the plants. The work is cooperative with the Biochemistry Department of Cornell University and the U. S. Plant, Soil and Nutrition Laboratory. The work involves 11 professional federal man-years annually.

Progress: Most of the work in studies of the intermediate chemical processes in the biosynthesis of protein has been concerned with the amino acid-specific ribonucleic acids that are found in the "soluble" fraction of cells and are thought to transfer amino acids to specific sites on the "template" during protein synthesis. It has been found that certain of the ribonucleic acids, for example, the threonine- and tyrosine-specific ribonucleic acids, have widely different partition coefficients in a new countercurrent distribution solvent system. These results suggest that there are major structural differences between different amino acid-specific ribonucleic acids. It has been found that the threonine- and tyrosine-specific ribonucleic acids show the same countercurrent distribution behavior whether isolated from rat liver or from yeast. This suggests that the major structural features of these two amino acid-specific ribonucleic acids are the same in yeast and in rat liver.

It has been observed in the countercurrent distribution studies that the addition of magnesium chloride to the solvent system has a stabilizing effect. This observation led to a study of the metal content of these ribonucleic acids. Analysis by means of the x-ray spectrograph indicated the presence

of approximately 0.3 atom of iron and of zinc per molecule of ribonucleic acid. It was found, however, that dialysis against potassium ethylenediaminetetraacetate removes almost all of the iron and zinc without any detectable change in the activity of the ribonucleic acid as an amino acid acceptor, suggesting that iron and zinc are not integral parts of the ribonucleic acid structure.

A number of studies have been carried out on the reactions of the amino acid-acceptor ribonucleic acids with formaldehyde, glyoxal, bromine and nitrous acid. The results, which indicate differing stabilities of the different amino acid-specific ribonucleic acids, may be of value in determining the structural features of the ribonucleic acids essential for activity. Partial purification of the threonine- and tyrosine-activating enzymes from rat liver has been accomplished by chromatography on diethylaminoethylcellulose followed by ammonium sulfate fractionation. The tyrosine-activating enzyme has been found to require potassium ion for optimum activity.

The dietary intakes of copper and zinc on certain aspects of vitamin B₁₂ metabolism have been investigated in cooperation with the Department of Biochemistry at Cornell University. Dietary zinc depressed growth and hemoglobin in the rat and decreased the amount of the fatty acid activating enzyme (thiokinase) and the vitamin B₁₂ concentration in the liver. Additions of copper to the diet did not correct either condition. In fact, copper added to the basal diet also resulted in a lower thiokinase activity. The level of liver B₁₂ was also reduced but not to a significant degree. The addition of a high level of vitamin B₁₂ to the basal diet had no effect on growth nor humoglobin formation although the B₁₂ content of the liver was greatly increased. Vitamin B₁₂ added to the zinc diet almost completely reversed the effect of zinc on the liver stores of B₁₂, but had no effect on the enzyme level, growth nor anemia. In vitro additions of copper and zinc had no effect on the assay systems of either vitamin B₁₂ nor thiokinase. It is possible that copper and zinc work similarly in inhibiting thiokinase activity and in reducing B₁₂ liver stores. It may also be postulated that zinc interferes with absorption of B₁₂ or increases its urinary excretion.

A study of the principal mechanisms of ammonium nitrogen assimilation which function in Chlorella vulgaris was made. The organism was starved of nitrogen slightly by growing on a low nitrogen medium and the cells were harvested just at the time growth leveled off. Experiments were performed in which an N¹⁵-labelled ammonium salt was given to cells which were killed after one minute and the N¹⁵ content of alanine, glutamic acid, and glutamine from the cells was determined. The results indicated that ammonia is incorporated into glutamic acid and that alanine is formed by transamination from glutamic acid to pyruvic acid. These results constitute strong evidence for the theory that the principal port of entry of ammonia into the amino acids is via a reversal of the reaction catalyzed by glutamic dehydrogenase.

An investigation of the metabolism of intermediates occurring in the Krebs-Henseleit cycle of mammals and other organisms was also made with nitrogen-starved Chlorella cells. Unlabelled intermediates, ornithine, citrulline,

arginine, and urea, as well as C¹⁴-labelled ornithine, arginine and urea, were given to cells and changes in free amino acids of the cells were measured. The increases in certain acids and the labelling of them with C¹⁴ yielded certain information about the reactions involving those compounds in Chlorella. The results indicated that certain reactions of the cycle occurred, but it appeared that arginine metabolism in that organism did not follow the course expected if the complete cycle were operating. Other experiments indicated that the expected interrelationship between ornithine, glutamic acid, and proline existed in this organism. In addition to these experiments N¹⁵-labelled urea was given to the cells to gain some idea as to how urea is utilized by Chlorella.

Studies of factors affecting nitrogen metabolism in plants has continued with the discovery and isolation of two additional amino acids. Meta carboxyphenylalanine, and acidic amino acid, was isolated from iris bulbs by the use of ion-exchange techniques. The structure of the isolate has been determined by the usual methods including comparison with infra red spectra of the synthesized compound. A peptide containing B-aminoisobutyric acid and glutamic acid has also been isolated from plant tissue. In the process of isolating this peptide a sufficient quantity of beta-alanine was also isolated for identification. Hence, for the first time proof was obtained by other than chromatographic methods for the presence in plants of this compound.

Plans: Work on the factors affecting protein synthesis will be continued.

Publications: Part II FOOD COMPOSITION

1. Mineral Elements in Fresh Vegetables from Different Geographical Areas. H. Hopkins and J. Eisen. Journal of Agricultural and Food Chemistry 7: 633-638, Sept. 1959.
2. Comparative Vitamin B₁₂ Assay of Foods of Animal Origin by Lactobacillus leichmanni and Ochromonas malhamensis. H. Lichtenstein, A. Beloian, and H. Reynolds. Jour. of Agricultural and Food Chemistry 7: 771-774, Nov. 1959.
3. Note on Growth Response of Ochromonas malhamensis to a Microbiologically Active Red Pigment Isolated From a Commercial Vitamin B₁₂ Fermentation. A. Beloian, H. Lichtenstein, and H. Reynolds. Jour. of the Association of Official Agricultural Chemists 42: 648-650, Aug. 1959.
4. Chromatographic Separation of Vitamin B₆ Components in Food Extracts. E. W. Toepfer, M. J. MacArthur, and J. Lehmann. Jour. of the Association of Official Agricultural Chemists 43: 57-59, Feb. 1960.
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7. Nutritive Value of Foods. Home and Garden Bulletin No. 72.
8. Partition chromatography and its use in the plant sciences. J. F. Thompson, S. I. Honda, G. E. Hunt, R. M. Krupka, C. J. Morris, L. E. Powell, Jr., O. O. Silberstein, G. H. N. Towers, R. M. Zacharius. The Botanical Review 25; 1-263 (1959).
9. Purification of plant amino acids for paper chromatography. J. F. Thompson, C. J. Morris and Rose K. Gering. Anal. Chem. 31; 1028-1031 (1959).
10. The determination of amino acids from plants by paper chromatography. John F. Thompson and Clayton J. Morris. Anal. Chem. 31; 1031-1037 (1959).
11. An alanine-dependent, ribonuclease-inhibited conversion of adenosine 5'-phosphate to adenosine triphosphate. II. Reconstruction of the system from purified components. R. W. Holley and J. Goldstein. Jour. Biol. Chem. 234; 1765-1768, 1959.
12. Countercurrent distribution of rat-liver, 'soluble'- fraction ribonucleic acids. R. W. Holley, B. P. Doctor, Susan H. Merrill, and Farida H. Saad. Biochem. Biophys. Acta 35:272-273 (1959).
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14. The metabolism of nitrate and ammonia by Chlorella. G. S. Reisner, R. K. Gering and J. F. Thompson. Plant Physiol. 35; 48-52 (1960).

III. FOOD CONSUMPTION AND DIETARY LEVELS

A. CONSUMPTION OF FOOD--HOUSEHOLDS AND INDIVIDUALS

HHE

Problem: Current information on food consumption and dietary levels and food management practices as related to various socio-economic characteristics of different population groups is needed for research and education programs in nutrition and home economics.

Program: A continuing long-term program of food consumption studies, with nationwide surveys at intervals of about 10 years, supplemented by smaller special-purpose studies (occasionally in cooperation with the States). Work requires 6 to 7 professional federal man years annually.

Progress:

1. 1955 Food Consumption Survey. Report 15 of the 1955 Household Food Consumption Survey series--"Food Consumption and Dietary Levels as Related to Employment of Homemaker, United States, by Region" has been published and some progress has been made on other reports planned for this series, and on investigations based on further analysis of the survey data.

More than a quarter of the homemakers reporting on food consumption of their households in the spring of 1955 were employed outside the home. Households with these employed homemakers were smaller on the average than others, and fewer had children under 16--47 percent as compared with 61 percent. Only at the lowest income level--under \$2,000--did more of the employed than of the not employed homemakers have children.

Most of the employed homemakers were in nonfarm households. Only about 10 percent of the rural farm homemakers were employed away from home at the time of the survey, compared to nearly 30 percent of those in urban communities. About the same proportion of homemakers worked outside the home in the North as in the South.

Families with employed homemakers had higher incomes than the others, on the average. A major motive inducing wives to work outside the home is to add to family income. Certainly some of the added income permitted expenditures for more expensive food: (1) With each \$1,000 per year additional income, urban households--whether with homemaker employed or not employed--spent, on the average, an additional 43 cents per person for purchased food used at home in a week, (2) even with no difference in income the per person expenditure of urban households averaged 56 cents greater in households in which the homemaker was employed than in households in which the homemaker was not employed.

Consumption per person of meat, poultry, and fish and of bakery products was greater in households with employed than with nonemployed homemakers. This was true at low- and high-income levels, in urban and rural areas, and in the North and South. Almost as consistent was the tendency for the employed group to use more fats and oils and beverages.

Only for flour and other cereal products and the relatively small food group including dried fruits and vegetables was there a fairly persistent tendency for the households with the homemaker not employed to use larger per person amounts than those where she was employed.

The time-saving aspect of the use of prepared or partially prepared foods doubtless helps to explain their importance in households with employed homemakers. However, not all "convenience" foods are used to a greater extent in households with homemakers employed than in others. There is no evidence that the employed homemaker used flour mixes more than--or even as much as--the homemaker who did not work outside the home. Apparently she simply did not do much baking either "from scratch" or with the aid of a mix. She bought ready-baked bread, rolls, and cakes from the store instead. Nor is there evidence that such newer convenience items as frozen vegetables, fruits and juices, or canned soups, jams and jellies were used more consistently by employed than by nonemployed homemakers.

In general, families with working homemakers spent more for all food away from home, meals and snacks, than did families in which the homemaker was not employed. When the homemaker works away from home she may buy her noon meal or food or drink to supplement a home-packed lunch. Also, the family may eat out to save the homemaker's time or energy.

There is no evidence from this study of any clear-cut relationship between employment of the homemaker and adequacy of the diets. Though there were some differences in the proportion of households whose food in a week furnished the National Research Council's recommended allowances of eight key nutrients, the differences were generally small. For only two of these nutrients--thiamine and riboflavin--were there statistically significant differences between the percentages of the two groups of households having diets that met the allowances. Households with employed homemakers were less likely to have the recommended quantities of these two vitamins.

In response to need, new ways have been found in which the data from the 1955 survey of household food consumption may be presented for the convenience of certain users. For example, mimeographed tables were prepared, which show for each region and for the United States food consumption per person, in a week and in a day, for each of some 300 food items or groups of items, together with percentage of households using each item. In the table for the United States, figures were included showing the amount of calcium in the amount of food consumed per person per day in order to provide the basis for estimating the strontium-90-calcium ratio in these foods. Also of importance in interpreting food consumption are estimates, in preparation, that will show for major items and groups of items the ninth or eighth decile points--that is, 10 or 20 percent of households had consumption as great or greater than the quantities to be shown.

Plans: Three more of the reports originally planned for the 1955 survey

remain to be published. These are concerned with food consumption in relation to household size and education of the homemaker and special analyses of the nutritive content of household food supplies. Work will proceed on these as well as on some additional analyses, largely of a statistical and economic nature.

2. Survey of Diets of Selected Low-Income Population Groups. One of the objectives of the food consumption survey of beneficiaries of Old Age and Survivors Insurance conducted in Rochester, New York in the spring of 1957 was to discover whether these older groups experienced difficulties in marketing and storing food that might affect their food patterns and the quality of their diets. Hence, a section of the schedule included questions on marketing practices and storage facilities. Results of this special study have been summarized in an article prepared cooperatively with staff of Cornell University.

From the data collected in the survey, there is little to suggest that the older households found marketing for food items a particular problem. Generally, these households managed to do their own marketing, patronized price-competitive stores, preferred those nearby, tended to shop more or less infrequently, and had adequate food storage facilities.

Food expenditures varied widely among households included in the survey. The lowest 10 percent of the households reported expenditures for purchased food used at home in a week ranging from \$2.47 to \$4.31 per person, and the highest 10 percent reported expenditures ranging from \$12.41 to \$21.30. There were slight differences in marketing practices between the two groups but certainly these differences did not seem to explain the wide range between the lowest and highest food expenditures.

Minor differences in marketing practices did exist among households classified according to nutritive level. Households having better diets seemed to do more shopping around, were apt to patronize two or more stores, and traveled somewhat farther for their groceries, and relied more on route salesmen. Perhaps having milk and eggs on hand, the items purchased most frequently from route salesmen, led to greater use of these items and thus raised the dietary level of the households.

These differences in marketing practices, however, do not seem to provide a causal explanation of the nutritional level achieved by the households. It is more likely that the households having better diets and probably enjoying better health were more interested in food and, hence, participated more actively in the marketing process.

Plans: A report is being prepared which will describe the food consumption of this group of Rochester households, the adequacy of their diets, and their food problems, as well as a discussion of methodological problems involved.

3. Household Practices in Handling and Storage of Frozen Foods. In order to obtain background information for use in providing material to help

families improve their food management practices, surveys of household practices in handling and storage of frozen foods are being made, under contract, in two cities--Baltimore, Maryland, and Indianapolis, Indiana. The Baltimore survey was made in September 1959, with a repeat visit to the same households in January 1960. The Indianapolis survey is to be conducted in July 1960 and January 1961. Hence, possible seasonal differences in practices are being investigated. Information provided by the households surveyed include the length of time frozen foods are held out of storage between the retail outlet and the home, whether special wrappings are provided, the length of time the food is held in home storage, and the temperature of the compartment in which frozen food was being held at the time of the interview. In the Baltimore survey, separate data were obtained for frozen fruits, vegetables, and juices; in Indianapolis, information will also be obtained on frozen baked goods, and meat, poultry and fish.

Plans: At the completion of the collection and tabulation of the data from the Indianapolis survey, a report of findings from the two cities will be prepared. In evaluating household practices with respect to the time frozen foods are held and the temperatures of frozen food compartments, findings from time-temperature tolerance studies will be drawn upon.

4. Improving Evaluation of Family Food Consumption. Current interest in the calorie value of diets and the proportion contributed by different types of foods has prompted recent studies of household food use and discard to help interpret survey data on food consumption. Since there was little experience in obtaining this kind of information, methodology had to be developed as the studies progressed. A pilot study of urban households in St. Paul, Minnesota, in 1958-59 was followed by one in DeKalb County, Missouri, in which a random sample of farm households participated. Another segment of these investigations has been initiated in a city in California under contract with the University of California at Los Angeles.

In these studies, day-to-day records of food used and discarded have provided a basis for developing key questions which might be asked as part of a survey of household food consumption. To test the feasibility of this shortened method of obtaining information on discard of food during a 7-day period, a study using the recall method was made in winter, 1960, with a random sample of over 300 households in Minneapolis-St. Paul. Data are being processed and analyzed.

Another contribution to the improvement of methods of conducting dietary studies was described in an article "Some problems in collecting dietary data from individuals." In this study of the food intakes of a small group of business and professional men in Minneapolis-St. Paul, a record for one week proved as satisfactory as for two consecutive weeks and the recall method proved as satisfactory as the record method.

Plans: Tabulation and analysis of data on household use and discard of

foods is under way and the first of several planned reports is now in preparation for a journal article, "Use and Discard of Food in Some St. Paul Households." Other reports will follow as analysis of data is completed. No further field work is contemplated until results of this series of studies have been evaluated.

B. MATERIALS FOR NUTRITION EDUCATION AND FOOD MANAGEMENT

HHE

Problem: There is continuing need for up-to-date, authoritative information on nutrition and food management for use of nutritionists, teachers, social workers, and others concerned with nutrition and health and the wise use of family food dollars.

Program: An ongoing research program to evaluate the nutritional adequacy of food supplies and diets, to point up problems needing emphasis, to interpret and apply research findings on nutrition in the development of source materials for nutrition education and for food management through nationwide agricultural, educational and health programs. This work involves about 8 professional federal man years annually.

Progress:

1. Nutritional Analysis of the U. S. Per Capita Food Supply, 1909 to Present. Annual estimates of the nutritive value of the United States per capita food supply have been made and presented in periodic USDA publications--the National Food Situation (annual Outlook issue), the "Supplement for 1958 to Consumption of Food in the United States, 1909-52," and in "Agricultural Statistics, 1959." Analyses to meet special research needs have also been made. For example, to assist in estimating the amount of strontium-90 provided by vegetables and fruits in the national food supply, these foods were grouped into four classes--those grown below ground, above ground with the edible portion, exposed, those above ground in pods, husks, etc., which are removed, and those with skins that may or may not be removed. The amount of calcium provided by each of the four groups was calculated to use as a base for estimating the strontium-90 of the national diet.

Plans: The nutritive value of the per capita food supply will be computed annually for release in the Outlook issue of the National Food Situation and possibly other publications. Information provided by this series of estimates will continue to be drawn upon for many purposes.

2. Household Food Budgets. As the family food budgets developed by the Division have been used more and more widely, requests have been received for adaptations to make them more useful for special purposes. For example, at the request of the Bureau of Public Assistance, Social Security Administration, Department of Health, Education, and Welfare, the 19 sex-age groupings of the food plans have been reduced to 5 or 6 so that the same groups can be used by that agency for setting up both food and clothing budgets. The groupings suggested recognized the major growth patterns of children and the age and activities of the majority of adults in welfare programs. The food plans suggested for use are nutritionally adequate for the sex-age groups included in the simplified categories.

With advancing knowledge on fat metabolism a need has been felt for information on the amounts of fatty acids, sugars and starches, provided in the food plans. Estimates have therefore been made of the average amounts of these components in the eleven food groups on which the food plans are based. Such estimates make it possible to evaluate the level of these nutrients in the food plans.

The interpretation of the food plans through conferences with interested groups, usually social workers, has continued--for example, with the Budget Standard Service of the Welfare and Health Council of New York City. Consultation and review services have included work with the Department of Labor, Bureau of Employment Security in the calculation of the nutritive value of meals for which contracts were being offered for bids for the feeding of Mexican migratory laborers; and with staff writers of national magazines who were preparing articles on food costs and food budgets.

Plans: The annual pricing of the USA food budgets by regions and the low-cost food budget for the South, initiated this year, will continue. Quarterly pricing of the food plans using average USA prices will be done as heretofore. Estimates of cost will be carried in quarterly issues of Family Economics Review. The bulletin on the development of the food budgets, now in preparation, will be completed.

3. Basic Data for Food and Nutrition Programs. Research findings on nutritional requirements, food consumption, and nutritive value of foods are drawn on for the development of materials for use in food and nutrition programs. These publications focus on special problems encountered by nutrition workers in trying to help people improve their nutritional health through better diets. One of the major nutrition problems today is weight control. A new publication "Food and your weight," Home and Garden Bulletin No. 74, provides basic information to help individuals and nutrition workers deal with this problem. Included are discussions of daily calorie needs for desirable weights, energy expenditure for different activities, and control of weight through selection of a well-balanced diet based on four major food groups--the milk group, meat group, vegetable and fruit group, and bread and cereal group. Suggestions are given for planning meals and adapting them to both low and high calorie levels. The way in which snacks and beverages contribute extra calories is pointed out. A table of calorie values for some 350 common foods is included.
- Information compiled under this project has been drawn on to assist other agencies in the Department with problems of food planning for defense. Assistance has been given to the Food and Materials Requirements Division, CSS, USDA, on the shelter food plan being developed jointly with the Government Printing Office. During the report period a preliminary manuscript has been reviewed and suggestions made. Another request was for a table showing minimum and maximum percents of calories from major food groups to serve as a guide for management of food supplies following a disaster.

Plans: The manuscript on nutrition and the food dollar, now in preparation, will be completed for publication. A new bulletin on fats is planned for inclusion in the series "Facts for Consumer Education." The current emphasis on the role of fat in human nutrition points up the need for information on the consumption and household uses of different kinds of fats and oils, and on their composition and nutritive value.

4. Contribution to Nutrition Programs. Another medium for channelling information to workers in nutrition education and school lunch programs is through the periodical "Nutrition Committee News." Five issues were published in 1959-60. One issue featured some of the problems of feeding older adults in institutions along with practical suggestions for operators of these homes. In two issues nutrition education programs in schools were discussed, with emphasis on what to teach, effective methods and activities, involvement of home and community, and evaluation of program. Because it is believed that a good school lunch program can make an important contribution to nutrition education one issue of Nutrition Committee News was developed around the topic "Increasing the acceptability of the school lunch." A fifth issue contained examples of how nutrition information is disseminated and experiences are exchanged through institutes and workshops. The many requests for extra copies of some of these issues for use in workshops and conferences suggest that these articles are meeting a real need.

Plans: Among the topics planned for the coming year are: Nutrition education activities abroad; Science fairs--a means of learning nutrition; Nutrition and dental health; and nutrition education of public health workers.

Publications: Part III FOOD CONSUMPTION AND DIETARY LEVELS

Section A - Consumption of Food

1. Family Economics Review articles:
 - a. Age of the Homemaker and Food Consumption of the Household. Janet Murray. September 1959.
 - b. Food Consumption and Dietary Levels of Households with Employed and nonemployed Homemakers. Janet Murray. June 1960.
2. Food Marketing Practices of Older Households, Gwen J. Bymers and Janet Murray, Journal of Home Economics, Vol. 52, No. 3, March 1960.
3. Food Consumption and Dietary Levels of Households as Related to Employment of Homemaker--United States, By Region, Household Food Consumption Survey, 1955, Report No. 15. June 1960.
4. Food Consumption per Person in Households in the United States, Northeast, North Central Region, South, West, 1955 (HHE (Adm.)-200). June 1960. Mimeo.

5. Some Problems in Collecting Dietary Data from Individuals. Sadye F. Adelson. Jour. Amer. Dietet. Assoc; 36(5): 453-461. May 1960.

Section B - Materials for Nutrition Education and Food Management

1. Family Economics Review articles:

- a. Estimated Cost of One Week's Food -- U.S.A. Average and Four Regions. Eloise Cofer. September 1959.
- b. An Adaptation of the Low-Cost Food Plan for the South. Eloise Cofer. September 1959.
- c. Using the Estimated Cost of One Week's Food in Budget Counseling. Eloise Cofer. March 1960.
- d. Estimated Cost of One Week's Food: U.S.A. Average--July 1959; October 1959; January 1960; April 1960; Four Regions--July 1959; January 1960.
2. Supplement for 1958 to Agriculture Handbook No. 62, Consumption of Food in the United States, 1909-52, Tables 44, 45, and 47. September 1959.
3. National Food Situation (1960 Outlook issue) -- Table 4 and Nutritional Review. NFS-90, USDA. October 1959.
4. Agricultural Outlook Chartbook -- 3 charts. October 1959.
5. The Place of Potatoes in the Diet. Eloise Cofer. A talk before the Potato Division of the United Fresh Fruit and Vegetable Association, Chicago, Illinois, February 1, 1960. Mimeo.
6. Family Fare. Home and Garden Bulletin No. 1. (Revised in cooperation with Human Nutrition Research Division.) May 1960.
7. Issues of Nutrition Committee News:
 - a. Nutrition Activities in Elementary Schools. Mary M. Hill. July-August 1959.
 - b. Feeding Older Folks in Institutions, September-December 1959.
 - c. Exchange of Nutrition Information through Meetings. Mary M. Hill. January-February 1960.
 - d. Increasing Acceptability of the School Lunch. Mary M. Hill. March-April 1960.
 - e. Nutrition Education Demonstrations. Clara Mae Taylor. May-June 1960.

8. Food and Nutrition Services of Federal and Quasi-Official Agencies of the U. S. Eighth Edit. Compiled by Nutrition Programs Service, ARS 62-9. May 1960.
9. Research and Education for Better Family Nutrition. Esther F. Phipard. Presented at 33rd Annual Meeting of Texas Agr. Workers Assoc., Waco, Texas. November 5, 1959. Proceedings.
10. Evaluation of Protein Nutrition. A report of the Food and Nutrition Board, NAS-NRC Pub. 711. November 1959. (Chapter on Protein and Amino Acid Content of U. S. Diets contributed by Esther F. Phipard.)
11. The Recommended Allowances in Assessing Diets--Role in Studies of Individuals and Groups. Esther F. Phipard. Jour. Amer. Dietet. Assoc. 36(1): 37-41. January 1960.
12. Food and Your Weight. Louise Page and Lillian J. Fincher. Home and Garden Bulletin No. 74.

IV. FOOD QUALITY AND HOUSEHOLD USE

A. BREEDING AND MEAT CHARACTERISTICS

AH

Problem: Accurate and effective methods are needed for the evaluation of important meat quality and quantity attributes of carcasses and cuts of pork, beef and lamb developed from various breeding, management, nutritional and physiological research and which can be used by animal breeders and feeders to develop more productive animals with higher quality meat for the consumer.

Program: This is a long-term program involving basic research to design new measures and to determine if these and other objective measures of important meat quality and quantity attributes can be established and applied in the evaluation of breeding, nutrition, management and physiological studies of meat producing animals. Work is conducted at the Agricultural Research Center, Beltsville, Maryland in cooperation with Human Nutrition and with several State Agricultural Experiment Stations. About four professional federal man years are involved annually.

Progress: An analysis of the data from 60 pork loin samples, heated to an internal temperature of 165°F. showed a highly significant correlation between the ether extract fat of the ham lean and tenderness and desirability of flavor of lean as judged by a trained palatability committee. These samples were from hogs that varied widely in thickness of back fat. Average back-fat thickness and ether extract fat of the ham lean was found to be associated at a highly significant level. This study is being conducted to determine the degree of fatness that will give the highest quality of pork and can be used as a guide in the development of hogs that will produce the highest quality product. A similar study with 9-10-11 beef rib samples does not show that ether extract fat of the rib eye muscle is related to tenderness as judged by the palatability committee. However, there was a high interrelationship between tenderness, quality and quantity of juice and desirability of flavor of fat and lean. These samples were from 329, ROP steers that varied widely in fatness, but were all slaughtered at 900 pounds final feed-lot weight.

Studies have continued to show that the pressure method for determining tenderness of raw meat is reliable. Small biopsy samples are now being taken from six and eight month old calves to determine if the method will be a reliable procedure for use in selection purposes. Work is continuing to show a variability of free-amino acids in the muscles of beef animals that vary in tenderness. A second biopsy sample is taken at the same time as the sample for the pressure method to evaluate the variability of the free-amino acids in relation to tenderness. Likewise a micro-technique for determining hydroxyproline is being used to evaluate a third biopsy sample. Present data indicates these three methods are fairly well in agreement.

Continuation of the study to determine the different forms of collagen in raw and cooked meat indicates that only very small percentages of the total hydroxyproline occurs in the neutral salt and citrate extracts from meat from steers 13-16 months of age. Preliminary results using the modified Lowry

procedure for determining collagen and the Newman method for hydroxyproline indicates that losses of collagen nitrogen during cooking appears to be under 50 per cent for those steaks cooked rare or to 61°C., but above 90 per cent from those braised very well done at 100°C. This work is being done under cooperative agreement with Texas Agricultural Experiment Station.

Color in meats is being studied using a new Hunter Difference Meter, believed to be the most sensitive instrument available. Preliminary results indicate that small differences in color can be detected, especially in beef. Study of color in pork, from 75 pound pigs to 275 pound mature animals is now underway. Likewise, color in lamb meat is being investigated.

Plans: Continue these studies of objective methods of determining certain desirable factors in the production of meat of the highest quality. As the reliability of the methods are determined, they will be made available for use in the selection of breeding animals.

B. COOKING QUALITY OF POULTRY

HN

Problem: Evaluations of the cooking quality of poultry of different kinds and feed history should include flavor and tenderness or other eating qualities, and also yield and composition or comparative economy in order to guide purchasers.

Program: The cooking quality of poultry is studied using samples of known production history representing characteristics common in market samples or involving experimental variables likely to affect the consumer quality of the poultry meat. Thus comparative studies have been made of small and large turkeys, of chickens receiving rations likely to affect flavor, or representing old and modern practices. About two professional federal man years annually are devoted to this work.

Progress:

1. Chickens. Comparison has been made of the tenderness, color, and yield of roasted meat from 3- and 5-pound chickens of fast-growing and slow-growing breeds which had been fed typical 1956 and 1930 rations (4). Flavor evaluations were reported previously (1). Neither the breeds of chicken nor the rations studied had any appreciable effect on the tenderness of the breast or thigh meat, and no consistent differences in tenderness were found between meat from male and female chickens or from 3-pound and 5-pound birds. Chickens of the fast-growing breed fed the 1930 ration tended to have the most yellow color in the cooked breast meat. Differences in percentage yields of cooked chicken meat between the fast- and slow-growing breeds or between those fed the 1956 and 1930 rations were slight. At 5 pounds, chickens had a higher proportion of fat than at 3 pounds. At 3 pounds, the slow-growing chickens had twice as much separable fat as the fast-growing chickens of that size. After roasting male chickens retained a greater percentage of the ready-to-cook weight and had more dark meat than female chickens. The females had more light meat, separable fat, and drippings, and more fat in the drippings.
2. Turkeys. Yields from Beltsville Small White fryer-roaster turkeys fed different experimental rations also were determined (5). The rations differed in source of protein -- animal and vegetable combined or vegetable alone, in the form in which vitamin A and D were given -- dry or in fish oil, and in the addition of lard -- none, 4 percent, or 8 percent. Results on eating quality were reported in 1958. Neither the source of protein nor the form of the vitamins made any appreciable difference in the amounts of light meat, dark meat, fat, skin, or bone from the cooked turkeys or in the cooking losses. The ration containing 8 percent lard resulted in slightly lower percentage yeild of cooked light meat and higher separable fat, but the total percentage of cooked edible turkey (including lean, fat, and skin), about 54 percent of ready-to-cook weight and 36 percent of live weight, was comparable to that for turkeys

fed the other rations. In general, after roasting at 325° F. or braising at 450°, about 28 percent was light meat, 18 percent dark meat, 9 percent skin and fat, and 18 percent bones, based on the weight of ready-to-cook turkeys.

Plans: Studies on poultry will be continued as needed to provide answers to specific questions. For example, a new question arising out of changed practices in marketing has to do with comparative yields and economy of cooked meat from pieces of cut-up chicken marketed at different prices for the sorted pieces and the whole bird. The eating quality of poultry cooked with different amounts of fat will be investigated with emphasis on short preparation and cooking procedures.

C. QUALITY OF COOKED PORK

HN

Problem: Consumer studies show a preference for lean meat but little is known to what degree fat within the lean (marbling) contributes to tenderness and palatability and the comparative quality of trimmed meat cuts from fat hogs and lean cuts from meat-type hogs. Attributes of the raw product as marketed that are responsible for desired characteristics in the cooked product need to be defined in terms that would guide consumers in making purchases, and help producers, processors and distributors in supplying the kinds of processing and merchandising wanted by consumers.

Program: A continuing program at Beltsville, Maryland, has been studies of pork quality, in which cuts from carcasses of animals of known history with respect to breed, feed, and carcass characteristics, as well as cuts of retail origin, are being analyzed for cooking quality, palatability characteristics, yield and nutritive value. About 3 professional federal man years are involved in HN. The series of studies have been cooperative with Animal Husbandry Research Division and some under contract with Iowa State University.

Progress:

Braised Pork Chops. The relation of cooking yield and eating quality of pork chops to marbling of the lean and to backfat thickness on the hog carcass was investigated under contract with Iowa State University. Pork loins from hogs of known backfat thickness were trimmed to 1/4 inch external fat at the packing plant. Statistical analyses revealed that in both the rib and loin chops the regression of marbling on backfat thickness was significant at the 5 percent level ($b = 0.6$). However, there was considerable variation in marbling among animals with the same amount of backfat.

Percentage total cooking losses of braised 1/2 inch thick chops were not affected by amount of backfat on the carcass, but cooking losses from evaporation decreased and dripping losses increased with increasing backfat, as might be expected. Percentage of separable fat on raw or cooked rib or loin chops increased and percentage of lean decreased with increased backfat on the carcass; for example, the rib fat averaged 16 percent at a backfat thickness of 1.0-1.2 inches; and 28 percent at a thickness of 2.0-2.3 inches.

Backfat thickness on the hog carcass did not affect tenderness, juiciness, or flavor of braised loin chops. On the other hand marbling of fat in the lean did influence tenderness and juiciness of the chops, but not the flavor. Regression coefficients indicated a significant improvement of 1 point in the tenderness or juiciness score for each increment of 2 points on the marbling scale.

Plans: The data from the extensive analyses of fat pork and lean pork at Beltsville described last year are being summarized and evaluated under contract. Manuscripts will be prepared for publication.

D. QUALITY OF VEGETABLES

HN

Problem: A problem of food users is to select well and to make the best use of the vegetables available in the market. In order to do this, information is needed on the nutritive values of the different kinds and forms of vegetables available, how to preserve their valuable qualities before and during cooking and how to prepare and serve them so as to be attractive and acceptable.

Program: A continuing long-term basic laboratory program is underway at Beltsville, Maryland, to ascertain the nutritive value and edible quality of selected vegetables as commonly prepared for the table. Vegetables selected for study are those now important in diets, or potentially important as sources of needed nutrients, and those most affected by nutrient losses and quality changes during cooking. Knowledge of the relation between eating quality and the physico-chemical changes that take place during cooking is sought to aid in the selection of cooking procedures for optimum quality under varying circumstances. Part of this research is cooperative with the Agricultural Marketing Service. At present about 4 professional federal man years annually is given to this work.

Progress:

1. Frozen vegetables. Concern for quality maintenance of frozen vegetables in the marketing channels and in households prior to ultimate use led to studies on the quality of frozen vegetables both as received from the local retail market and after cooking. Brussels sprouts, broccoli spears, cut green beans, green peas, green lima beans, and leaf spinach were studied. Selected brands of the vegetables were purchased from designated stores, and each brand-store combination was replicated four times for four consecutive seasons. For comparison, samples of frozen vegetables were obtained directly from a Maryland processor and fresh vegetables from the local market.

Criteria of quality used in uncooked green vegetables were the ratio of oxidized to reduced ascorbic acid, percentage of chlorophyll conversion to pheophytin, and changes in reflected color. For the cooked vegetables panel flavor scores proved to be a sensitive quality index.

Although there was considerable variation in quality of all vegetables

investigated, the number of distinctly low quality samples was small. The mean values for quality factors investigated in samples of frozen vegetables from the retail market were in most cases similar to those for samples obtained directly from the one processor. Mean values for ascorbic acid content of frozen vegetables as purchased were usually lower than for fresh. The ratio of oxidized to reduced ascorbic acid and the percentage of chlorophyll converted to pheophytin were usually higher for frozen vegetables than for fresh.

2. Electronic Cooking. The effect of microwave cooking on palatability and nutrient content of fresh and frozen broccoli was investigated at Beltsville, Maryland (9). The time for cooking broccoli to optimum tenderness electronically was found to be about 6 minutes for 1 pound of fresh broccoli compared with 13 minutes by boiling. Frozen broccoli took longer to cook electronically--13 minutes for 20 ounces of frozen broccoli compared with 11 minutes by boiling. Cooking broccoli in the electronic range took about 0.06 kilowatt-hour of electricity per minute; boiling, about 0.024 kilowatt-hour per minute.

Flavor of broccoli cooked to optimum texture of stems by microwave and by boiling was estimated to be about the same. Color retention in fresh broccoli cooked by microwave was slightly better than in that cooked by boiling; the differences in color of frozen broccoli cooked by the two methods were inconclusive. The ascorbic acid retentions in fresh and frozen broccoli cooked to optimum texture were estimated as higher in that cooked by microwave than in that cooked by boiling. There were no measurable losses in carotene content of fresh and frozen broccoli cooked by microwave.

Plans: Laboratory work on the quality of fresh, frozen, and canned vegetables has been completed and reports of this research are in preparation. The results will be reviewed to determine which direction the work should take, if extension seems justifiable within the funds available. Comparable laboratory work on fresh, frozen, and canned fruits is being carried out.

E. QUALITY AND USE OF PROCESSED MILKS

HN

Problem: Processed milks in various forms are available in the market today, but little comparative information can be had on their interchangeability in household use, especially in baked products. The problem has been accentuated by the availability of many types of dried milks from a variety of processing procedures.

Program: Work was undertaken to find out whether differences could be detected in the functional properties of processed milks in home baked goods. Considerable exploratory work was necessary to standardize methods and criteria for measuring the quality of milk as processed and the quality of the finished baked product. After methods were developed, representative types and brands of milks were compared and the data analyzed for significant differences. Less than two professional federal man years annually have been devoted to this work.

Progress:

Quality and Use of Different Forms of Milk. Investigation was made of the functional properties of six forms of milk--nonfat dry, dry whole, evaporated, fresh buttermilk, fresh whole, and fresh skim--with particular reference to the hydration of dry ingredient when used with different mixing times in baking powder biscuits (12). Differences in particle size or density of dry milks lead to variations in the weight-volume equivalents for reconstitution, and lack of uniformity among brands continues to present problems in household use. The results of objective measurements of volume, shear, pH, and moisture content and of panel evaluations showed that a mixing time of 14 seconds in an electric mixer was best for biscuits made with fresh whole, fresh skim, nonfat dry, and evaporated milk, and 20 seconds was best for biscuits made with fresh buttermilk and reconstituted dry whole milk. Whatever the type of milk used, an increase in mixing time beyond the optimum was usually associated with greater moistness of crumb, increasingly fine texture, and less tender crusts. The actual moisture content of the biscuits varied with the type of milk used rather than with changes in mixing times.

Plans: The laboratory work has been completed and the project discontinued. Two manuscripts have been prepared for publication.

F. AGRICULTURAL CHEMICALS AND FOOD FLAVOR

HN

Problem: To assure that agricultural and food processing chemicals cause no undesirable changes in flavor or other consumer qualities of foods which might interfere with their acceptance, palatability as well as wholesomeness must be ascertained in the developmental stages before the chemicals are marketed for use.

Program: HN maintains at Beltsville a continuing program cooperative with Divisions of Farm Research to investigate the effect of use of agricultural chemicals on flavor of commodities as prepared for eating. As sample size and variety permit, the Division also makes studies to improve methods of conducting palatability evaluation. About 2 professional federal man years annually are involved in HN.

Progress: The flavor of foods exposed to certain agricultural chemicals in their production has been investigated in continued cooperation among HN, CR, ENT and with the Northeastern Regional Research Project, NE-15.

Research in seven State Experiment Stations and the United States Department of Agriculture, coordinated through the Northeast Regional Research Project (NE-15), sought to determine the effect of insecticides and fungicides on the flavor quality of fruits and vegetables. During six years, the research involved 36 single insecticides, 11 single fungicides, and 29 combinations of insecticides or fungicides used in various dosage rates on 25 vegetables and 4 fruits.

Single insecticides inducing poor flavor quality in about 50 percent of the samples were BHC (benzene hexachloride), lindane, and toxaphene; and, in a smaller percentage of samples, endrin and malathion. When used singly PCNB (pentachloronitrobenzene) was the only fungicide that resulted in poor flavor quality. Combinations of pesticides tending to induce unfavorable qualities included toxaphene, sevin, DDT, malathion, captan, and thiram. Toxaphene treatments used either singly or in combinations which induced poor flavor quality were dosages greater than needed for control in the area where the crop was grown.

Pesticides giving no ill effects on flavor when used singly were chlordane, DDT, dibrom, dilan, dimethoate, heptachlor, phosphamidon, sevin, thiadan, trithion, Bordeaux, tribasic copper, and zineb. When used in combinations, diazinon, lead arsenate, and glyodin did not influence flavor adversely.

Plans: Cooperative testing for palatability and methodological studies of flavor evaluation will be continued as opportunity permits. Increased funds available to HN for 1960-61 will be used at first to initiate some basic studies of methodology of panel judging to help sharpen the acuity of taste testing, or other evaluations of effects of pesticides on quality. For example, problems of appearance of toughness or firmness resulting in uneven cooking in exposed vegetables needs to be investigated.

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V. PESTICIDE RESIDUES

ENT
CR
HN

Problem: Safe, effective and economical pesticides are needed which will not leave hazardous residues and which will not adversely affect the flavor, quality and palatability of food products and feeds. Application of pesticides--i.e. insecticides, herbicides and nematocides--are considered essential practices for the production of an abundance of high quality food. However, the use of such chemicals may result in serious residue problems. Consequently, it is necessary to determine with precision the distribution, persistence, and amount of residue of new pesticides, including metabolic products, when they are applied according to accepted recommendations. Such information is needed in order to obtain data on residues that are likely to occur on the harvested crops or livestock products and to insure that the Department's recommendations for control purposes do not result in residue levels which exceed tolerances established under the provisions of Public Law 518.

Program: A continuing long-range program of basic and applied research involving about 70 federal professional man years annually. There is formal and informal cooperation among various divisions of the Department with the Food and Drug Administration, private individuals, commercial organizations and with State Experiment Stations in about 20 states.

Progress: Agriculture Handbook No. 120 was revised early in the year to provide insecticide recommendations of the Department for the control of insects on agricultural crops and livestock for the 1960 season. Significant research findings with regard to insecticides were as follows:

Livestock Insecticides: Although preliminary studies reported last year indicated that Bayer 22408 did not produce residues in milk when fed to dairy cattle, subsequent studies show that small amounts of this organic phosphorus compound to appear in milk. Further work with Sevin has provided further confirmation that this carbamate insecticide can be applied directly to livestock or incorporated in feed with no storage in meat or milk.

Preliminary work with radioactive labelled ENT-24717 (Shell SD-4294), a promising organophosphorus compound, showed very small residues in tissues 48 hours after giving an oral dosage of 20 mg./kg. to a ewe. Milk from the ewe showed 0.0215 p.p.m. 6 hours after treatment which decreased to 0.0003 p.p.m. in 48 hours.

Further studies confirmed the original findings that the treatment of poultry houses with a 1-percent lindane residual spray resulted in moderate levels of lindane residues in the meat and eggs of chickens. Small levels were still present in the meat and eggs 16 weeks after treatment of the house. Since there is no tolerance for lindane in poultry or eggs, recommendations for use of this insecticide in poultry houses have been withdrawn.

Vegetable and Fruit Insecticides: Studies were continued in cooperation with industry and various State agricultural experiment stations in the development of safety measures to protect the health of consumers of vegetables harvested from fields treated with insecticides as well as to protect persons who handle and apply insecticides or who handle treated plants. Experimental data on the rates of disappearance of insecticides applied to vegetables in the field have provided a basis for establishment of safe waiting periods between last application and harvest for a number of insecticide uses. Studies of soil applications of insecticides have revealed some promising areas for decreasing applications directly to fruit trees during the growing season, thus minimizing the residue hazard. Applications of aldrin, dieldrin, chlordane, or heptachlor to the soil give good control of the plum curculio on peaches and soil injections of phorate in the spring show much promise of preventing outbreaks of mites on apples and probably other tree fruits.

Grain and Forage Insecticides: In Georgia, Coastal Bermudagrass treated with heptachlor granules at 2 pounds per acre on April 15, 1959, showed residues of heptachlor and heptachlor epoxide on the forage 61 days after treatment. Residues of heptachlor and its epoxide were also found in the soil after 61 days. Beef animals placed on the pasture 15 days after treatment showed heptachlor and heptachlor epoxide residues in the fatty tissue at slaughter. Milk samples (4 percent butterfat), from dairy animals placed on the pasture, showed insignificant amounts of heptachlor but did contain heptachlor epoxide for 28 days after exposure.

A similar experiment conducted under different growth conditions in October 1959, showed that residues of heptachlor and heptachlor epoxide persisted for 64 days on the forage and in the soil. Only negligible amounts of heptachlor were found in the fatty tissue of beef animals placed on the plots 15 days after treatment but heptachlor epoxide was present in these tissues at slaughter. In Montana, range grass was sprayed with 1/2 ounce of dieldrin per acre for grasshopper control. Residues were found on the forage 54 days after treatment. Beef cattle feeding on the treated range showed residues of dieldrin in the fatty tissue at slaughter. Sevin applied to Coastal Bermudagrass at 1 pound per acre produced higher initial residues when applied as a wettable powder than as dust or granules. On Soybeans the highest initial residues were also from wettable powder. Sevin has shown promise for the control of corn insects without creating a residue problem. When applied from 2-1/4-4-1/2 pounds per acre as a spray and 10 to 14 pounds per acre as a dust, residues did not exceed 2.3 p.p.m. on ears, husks, stalks, or leaves. This was well under the established tolerance of 5 p.p.m. for corn ears and 25 p.p.m. for fodder and forage.

Chemical Studies: Studies to determine the levels of heptachlor and heptachlor epoxide that would be found in the fat and milk of cattle grazed on pastures treated with granular formulations of heptachlor were completed. Heptachlor epoxide was excreted in the milk at all

dosages applied even when there was an interval of 30 days between treatment and beginning of the grazing period.

The fat from cattle fed apple pomace as a part of their diet was analyzed at 4-month intervals to determine the DDT residues resulting from ingestion of this insecticide in the pomace. It was found that more than a year on DDT-free feed was required to bring the residues in the fat down to the tolerance of 7 p.p.m.

Studies were conducted using radioactive insecticides to determine the metabolic fate of insecticides in cattle.

Several thousand samples of fruit, vegetables, cereals, forage crops, animal products, and soils, were analyzed to obtain information regarding pesticide residues, a basic step in the development of insecticide schedules for adequate insect control that do not leave undesirable residues in or on food reaching the consumer.

Herbicides and Other Pesticides: Research investigations in the field have shown that sweet potatoes have a tolerance to herbicidally effective levels of isopropyl N-(3-chlorophenyl)carbamate [CIPC] and ethyl N,N-di-n-propylthiolcarbamate [EPTC] applied immediately after transplanting sweet potatoes and/or after the last cultivation. In accordance with these results, it was felt desirable to determine the effect of these herbicides on flavor, texture, and color of the freshly cooked and canned sweet potatoes. Fresh and canned samples of Orange Little Stem sweet potatoes from control plots and plots treated with CIPC and EPTC were submitted to the Food Quality Laboratory for flavor, texture, and color evaluations. Results reported by the Food Quality Laboratory showed that texture and flavor were not affected by either of these herbicides as used in these treatments. It was found, however, that higher rates of EPTC reduced the color score of the potatoes and this was associated with a change in the red coloration. It was also found that samples from the CIPC treated plots exhibited a graying effect. These initial observations are not considered as conclusive but they do indicate the need for the continuation of studies of this type.

Plans: On insecticides, investigations will be continued to determine the rate of loss and magnitude of residues, including the amounts of decomposition products and/or metabolites, particularly since it has been shown that insecticides are sometimes converted to more toxic compounds on or in plants and in animals. Research will be intensified to find and develop new and safer insecticides and attractants which can be used in the control of insect pests on food, feed, and forage crops and on livestock without resulting in hazardous residues. Basic research will be undertaken to explore new approaches to insect control, including chemosterilants, antimetabolism agents, growth inhibitors, insect hormones, and gamma irradiation, that may ultimately replace residue-forming insecticides or reduce the amounts needed. The search for new parasites, predators, and diseases of insect pests will be

intensified and studies undertaken to find more effective ways to utilize these natural control agents and thus reduce the need for insecticides on food and feed crops.

On herbicides, research will be conducted on a continuing basis to determine the effect of promising new herbicides on flavor, texture, color, and other fundamental physiological response of crops to the herbicides. These studies will include evaluation of the fresh and processed product, where appropriate, using accepted commercial methods of preparation, processing, and storage.

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14. Accumulation and Dissipation of Pesticide Residues in Soil. Robert D. Chisholm and Louis Koblitsky. Trans. of the 24th North American Wildlife Conf., March 2-4, 1959. Pp. 118-123. (Received January 1960)
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18. Insecticide Residues, Colorimetric Determination of Residues of Phorate and its Insecticidally Active Metabolites. Paul A. Giang and M. S. Schechter. Jour. Agric. and Food Chem. 8(1):51-54. January 1960.
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21. Residue Studies of Livestock Sprays Containing Sevin. R. H. Roberts, J. B. Jackson, W. E. Westlake, A. J. Ackerman, and H. V. Claborn. Jour. Econ. Ent. 53(2):326-7. April 1960. (Scientific Note)

VI. TEXTILES AND CLOTHING

A. SERVICE PERFORMANCE OF FABRICS

CH

Problem: In selection of fabrics and of ready-made clothing and household textile articles, the consumer is often handicapped by lack of information about the performance characteristics of materials from which to choose.

Program: This is a continuing series of studies in which fabrics of known composition, construction and finish are subjected to laboratory evaluation before, during, and at the end of periods during which their serviceability for specific uses is being investigated. The purpose is to determine relationships between the nature of the fabric (e.g. fiber content, geometry, chemical finish, physical properties) and specific phases of use or care; to develop satisfactory timesaving methods of predicting performance; and to provide a better understanding of the interaction of different aspects of serviceability. This research, conducted at Beltsville, Maryland, involves approximately five professional federal man years annually, and is cooperative with various ARS divisions, state experiment stations, colleges, and private and commercial organizations.

Progress:

1. Properties and serviceability of knit fabrics. Findings from a recent phase -- using experimental filling knit fabrics in children's undergarments -- were presented in popular form in Food and Home Notes, February 17, 1960. A Research Achievement Sheet summarizing over 10 years of research on filling knit fabrics was issued.

A study of 60 two-bar tricot fabrics was completed and a manuscript reporting the findings has been accepted for publication in the Textile Research Journal. These findings were included in last year's progress report.

Research on raschel fabrics has continued.

A project was initiated to secure additional data on filling knit fabrics with special attention directed to the effects on end-use qualities of staple length of cotton fiber, mercerization, and blending of medium staple cotton with nylon. Physical properties of yarns and fabrics, and dimensional stability to laundering will be determined at Beltsville on experimental fabrics to be manufactured by the Spring City Knitting Company. This company, impressed by the published findings from the research summarized above, offered to cooperate on a study of this kind. It has assumed responsibility for procurement and testing of fibers and manufacture of yarns and fabrics, and for conducting studies of performance-in-use of undergarments made from the fabrics. CH has assumed responsibility for laboratory determinations of fabric properties, color, and dimensional stability before and after they are worn as garments.

Work is continuing with the Task Group on Knit Fabrics of Committee D-13 of the American Society for Testing Materials. This Task Group is developing test methods for measuring shrinkage and the restorability of knit fabrics after laundering.

2. Properties and serviceability of woven fabrics. Evaluation of data was continued and some remaining laboratory tests were made in an effort to complete some long-term studies of properties in relation to serviceability-in-use of cotton and wool in clothing fabrics.

In consultation with the Biometrical Services staff of ARS, evaluation was also made of data concerning the effect of color and dyeing method on the in-use soiling characteristics of cotton pile floor coverings, and a technical report is in preparation.

In-service studies of slip cover fabrics of different fiber composition and physical properties were continued.

Plans: Laboratory work now under way on the properties and dimensional stability of experimental raschel knit fabrics will be completed and reports prepared for publication. Laboratory work on filling knit fabrics now being manufactured will be initiated.

Evaluation of data and preparation of reports will be completed on experimental woven fabrics used in men's shirts and trousers.

Evaluation of data from research on cotton pile floor coverings and from a study of slip cover fabrics will be completed and reports prepared for publication.

A revision of an intermediate (teacher-leader) publication on making and hanging window curtains (HNHE-111) will be initiated if time permits.

Publications:

1. Characteristics and rate of wear of worsted serge in trousers. Rowena P. Dowlen and Roy L. Ward. Abstract in Jour. Text. Inst. 50 (9): A513, Sept. 1959.
2. Serviceability of garments made of 28 experimental cotton knit fabrics. Hazel M. Fletcher and S. Helen Roberts. Knitting Industry Weekly 76 (22): pp. 6-7, 19, Nov. 30, 1959.
3. Serviceability of garments made of 28 experimental cotton knit fabrics. Hazel M. Fletcher and S. Helen Roberts. Abstract published in Jour. Home Econ. 52 (3): 221, Mar. 1960.
4. Wale-course relationships affect dimensional stability and other properties of filling-knit fabrics. Hazel M. Fletcher and S. Helen Roberts. Research Achievement Sheet 203, USDA, 2 pp., June 1960.

B. LAUNDERING AND DISINFECTION OF FABRICS

CH

Problem: To help homemakers produce a cleaner, whiter, and microbiologically safer wash without damage to fabrics, information is needed on the effectiveness of various laundering agents and disinfectants in removing soil, while retaining original appearance and other desirable properties, and controlling microorganisms transmissible by, or injurious to, fabrics.

Program: This is a continuing program conducted at Beltsville, Maryland. Chemical studies are made of the effect of modern detergents, fluorescent whiteners, and other substances incorporated in household laundry products on fabrics of different composition, construction and finish. The purpose is to determine the kinds and concentrations of agents, and the washing temperatures which are most effective in removing soil, maintaining whiteness, and masking yellowness or other undesirable color changes; to obtain a better understanding of the nature of the yellowing observed in clothing and household textiles after wear and laundering, in order to identify some of the causes and develop means of prevention; and to investigate the basic factors influencing survival of bacteria from fabrics as a basis for developing improved disinfection procedures as well as standard methods for evaluating their efficacy. About 6 professional federal man years are involved annually.

Progress:

1. Effectiveness of representative laundering agents. Widely different effects were obtained from use of five different household detergents on unsoiled swatches of 12 nearly-white fabrics of cotton, dacron and nylon. The three detergents which contained pigments, compared with the two without pigments, had a graying effect on the cottons. The cotton finished with epoxy resin and additives developed redder, bluer, and greener colors. The pigments had some influence on the nylon-dacron-cotton fabric with urea-formaldehyde finish, but had practically no effect on final colors of the other nylon and dacron fabrics which were studied. The various fluorescent whiteners included in the detergents markedly whitened the unfinished cottons, but were less effective on the finished cottons. The whiteners masked some of the yellowness on the nylon fabrics, and had little effect on the dacron fabrics. A brief report of this research on the unsoiled swatches was given in a conference on wash-wear cottons at the Department's Southern Utilization Research and Development Division in New Orleans, Louisiana, in March 1960. A manuscript of a technical report has been accepted for publication in the American Dyestuff Reporter.

Data on the effectiveness of the same detergents at two different washing temperatures in removing soil from naturally soiled back shields made from the test fabrics are now being evaluated.

2. Effectiveness of selected fluorescent whiteners. As a result of the studies of representative household detergents, basic research has been initiated to determine the effectiveness of selected fluorescent whiteners of distinctive chemical structure in improving fabric color in relation to fiber composition and to fabric finish, as a basis for developing principles applicable to the selection and use of household laundering agents. This includes cooperation with the Department's Southern Utilization Research and Development Division which has an interest in the use of fluorescent whiteners in the mill-finishing of resin-treated wash-wear cottons to improve their color and overcome any tendency to discolor. The research will include evaluations of whitener performance and durability on fabrics of different fiber types with mill- and home-applied finishes as related to consumer use and care.

Cooperation has continued with ASTM Committee D-12 in developing methods of measuring the effectiveness of fluorescent whiteners on fabrics.

3. Causes of yellowing of cotton fabrics. Laboratory research on this subject has continued, with emphasis on the effect on cotton fabrics of some fluorescent whiteners of types commonly used in household detergents when the fabrics are exposed to oxides of nitrogen under conditions found in gas dryers, and when they are held under mild acidic conditions which might be found in fresh perspiration.

Data from research on the nature of yellowing have been summarized and are being evaluated. These deal with yellowing caused by non-cellulosic substances such as natural soil (nitrogenous and oily) and detergent residues, including fluorescent whiteners, and by the reactions between these substances and oxides of nitrogen in gas dryers and oxygen in the air. Technical reports are being prepared for publication.

4. Fabric disinfection. Expanding use of communal laundry equipment, including the self-service installations used by the general public, and of lower water temperature in home laundering necessitate control of microorganisms transmissible by clothing and household textiles. This transmissibility is influenced by such factors as kind of bacteria, type of fabric, temperature, and relative humidity. Recent research has been concerned with control of bacteria on household textile articles, using a quaternary disinfectant and a phenol disinfectant with a nonionic household detergent in a simulated wash cycle. Antimicrobial activity has been shown against Staphylococcus aureus and Escherichia coli on wool blanketing, muslin sheeting, and acetate tricot. These findings are of special interest because antibiotic resistant strains of Staphylococcus have recently received considerable publicity as causes of skin lesions, pneumonia, and post-operative infections; and Escherichia is a common intestinal bacterium which belongs to the same family as the typhoid bacillus.

Participation in the AATCC Antibacterial Agents Committee has been helpful in solving problems in methodology, such as development of a standard test method for quantitative evaluation of fabrics treated with antibacterial agents. Considerable progress was made when 13 members of the Committee met at Beltsville in a 3-day Laboratory Workshop, organized by the leader of this line project, on April 13-15, 1960.

Plans: A technical report on soil accumulation and removal of the 12 nearly-white test fabrics will be prepared for publication, and laboratory work will begin on evaluating typical fluorescent whiteners, under various use conditions, on different kinds of fabrics.

Technical articles describing the results of research on yellowing of white cotton fabrics will be completed. Since it has been found that the presence of non-cellulosic substances does not explain all of the yellowing found in worn and laundered cottons, research will probably be directed next toward study of the chemical changes in cellulose itself resulting from reactions with substances such as oxidizing and reducing agents, acids and alkalies encountered during wear, laundering, drying, and storage of cotton fabrics.

The present studies on survival of bacteria on three fabrics will be completed and a manuscript prepared for publication. A report will be prepared for publication on the antibacterial action and adsorption of a widely used quaternary disinfectant on five of the fabrics used for rate of soiling and soil removal (see VI-B-1). Laboratory research will continue on problems concerned with the evaluation of disinfectants suitable for use in the wash cycle of home laundering.

Publications:

1. Some problems involved in the use of quaternary ammonium compounds as fabric disinfectants. Ethel McNeil, Maurice Greenstein, L. S. Stuart, and Margaret T. Goldsmith. Applied Microbiology 8 (3): pp. 156-159, May 1960.
2. Some problems involved in the use of quaternary ammonium compounds as fabric disinfectants. Ethel McNeil, Maurice Greenstein, L. S. Stuart and Margaret T. Goldsmith. Abstract published in Jour. Home Econ. 52 (5): 364, May 1960.
3. How to prevent and remove mildew: Home methods. Margaret S. Furry. USDA Home and Garden Bul. No. 68, 14 pp., illus. June 1960. (Supersedes L-322)
4. Color effects produced in nearly-white fabrics by household detergents. M. S. Furry, P. L. Bensing, and M. L. Johnson. Accepted for publication by American Dyestuff Reporter.

C. CLOTHING REQUIREMENTS, DESIGN AND CONSTRUCTION

CH

Problem: Information is needed for determining the potentials of clothing in providing comfort, freedom for full use of physical capabilities, safety from the hazards that ordinarily involve clothing, and conveniences needed for efficiency in performing required activities. This information would serve as the basis for establishing principles which could be used to advantage by both manufacturers and home sewers in developing or selecting clothing for increased satisfactions and economy. Since garment satisfaction is also dependent on compatibility of fabric and construction, manufacturers of fabrics and clothing as well as home sewers need sound principles of construction as related to the composition, structure and properties of fabrics.

Program: Clothing needs and desires are determined by case studies. Laboratory investigations, based on the results of these studies as well as known principles of design, are then made and promising ideas are developed into experimental garments which are observed in actual use, and are further developed. Continuing studies at Beltsville are also directed toward solving problems in construction with present emphasis on the use of "easy care" fabrics and generally available types of sewing threads. Approximately two professional federal man-years annually are involved.

Progress:

1. Garments to meet needs of handicapped homemakers. Research has been completed on clothing for homemakers who, as a result of physical limitations, find available clothing a deterrent to their working efficiency and self-care. Principles of design and selection were established by a case study, the results of which were published in the October 1959 issue of the Journal of Home Economics, and an abstract appeared simultaneously in Rehabilitation Literature. These principles have now been applied to the development of various types of garments and garment accessories which contribute to the comfort, convenience, safety, work efficiency, and general practicability needed by these women, but are helpful to the able as well. A processed publication has been released for use by professional groups concerned with the handicapped and by commercial companies who may apply the findings to their products. This is to be superseded by a USDA bulletin now in preparation for printing.

A demonstration of the results of this research was made in June 1960 at a workshop sponsored by the Joint American Home Economics Association-American Dietetic Association Committee on Rehabilitation held in Denver, Colorado. A similar presentation will be made in November 1960 at the National Conference of the American Therapists Association in Los Angeles, California.

Three pattern companies have indicated interest in manufacturing patterns for selected designs. Cooperation is being extended to these companies as it will be to others interested in making the results of this research available to the public. Requests for reports of current and future research on clothing for the physically limited have been received not only from home economists, but also from physicians, occupational therapists, rehabilitation counselors, educators, and librarians, and from medical and health organizations.

To aid in disseminating the results of this research, cooperation has been given to the ARS Information Service in preparing releases for newspapers and periodicals, and in preparing a movie short for television use. Feature stories were carried by Agricultural Research and Farm Journal in July 1960. Many newspapers throughout the states carried articles apparently based on releases through Food and Home Notes, September 23, 1959 and June 15, 1960. An easel album was prepared for use at the Eighth World Congress of the Society for the Welfare of Cripples, which met in New York on August 28 to September 2, 1960. Duplicates of the original garments are being made and assembled as loan collections which will be available on request to interested professional groups, and to manufacturers. Preparation of slide sets and other ways of carrying the results of this research to the public are under consideration.

2. Principles of seam construction. In order to prevent early deterioration of garments due to improper fabrication, principles of construction of seams and edge finishes are being developed. The relation of thread strength and stitch length to efficiency of seams in 10 staple cotton fabrics has been investigated, the data are being subjected to statistical evaluation, and a report for publication is being drafted. Another report in preparation is concerned with laboratory evaluations of seam frayage. Four seam finishes (plain, double-stitched, pinked, and zigzagged) on ten fabrics, which differed widely in weight and weave, were subjected to repeated launderings in a home-type modified agitator washing machine. In a search for a laboratory method of predicting seam frayage due to laundering, the same seam finishes were also subjected to the random motion abrasion of an Accelerotor. The data from both phases of the study are being evaluated statistically. An informal report of this research was made at a conference on wash-wear cotton at the Department's Southern Utilization Research and Development Division in New Orleans, Louisiana, in March 1960.

Plans: Efforts will continue to meet the widespread and urgent demands from home economists and others concerned with rehabilitation, for aids in using results of the recently completed research on clothing for handicapped homemakers. This involves publications, loan exhibits, other illustrative material, and the collaboration of professional staff with representatives of the garment and pattern industries and professional organizations concerned with aids to the physically limited. Plans for new research in this area will be developed following consultation with leaders in rehabilitation.

Completed phases of research on seam strength and seam frayage basic to development of principles of construction of seams and edge finishes will be prepared for publication. A bulletin (HERR-1) on clothing fabrics will be revised with special attention to fiber nomenclature as established by the Federal Trade Commission as a basis for administration of the Textile Fiber Products Identification Act. Laboratory research cooperative with SU is being developed to determine the causes and prevention of seam pucker on cottons with special finishes.

Publications:

1. Clothing needs of physically handicapped homemakers. Clarice L. Scott. Jour. Home Econ. 51 (8): pp. 709-713, October 1959.
2. Clothing needs of physically handicapped homemakers. Clarice L. Scott. Abstract published in Rehabilitation Literature 20 (10): pp. 307-309, October 1959 (Digest 770).
3. Clothes for the physically handicapped homemaker -- with features suitable for all women. Clarice L. Scott. USDA processed publication, 28 pp., illus., issued May 1960, released June 1960.

VII. HOUSING AND EQUIPMENT

A. ENERGY EXPENDITURES IN HOUSEWORK

CH

Problem: Knowledge about the comparative amount of energy expended by women in using housing facilities and equipment of different designs and in performing household operations by different methods is needed as a basis for designing efficient storage, work areas and equipment, and for developing recommendations for their efficient use.

Program: This is a continuing laboratory study carried on at Beltsville, involving less than two professional federal man-years annually.

Progress:

Research has continued on the effect of type and arrangement of equipment and other factors on energy expenditures for work. A technical bulletin entitled "Energy expenditures of women performing selected activities," which reports data given in detail in the 1958 Advisory Committee report, was completed and is now in press.

During the current year determination of the effect on energy expenditures of women working at surfaces of different heights was completed. Results are being analyzed and technical reports drafted. The unique methodology developed for this research was discussed informally by the senior leader at a meeting of the D. C. Branch of the Institute of Industrial Engineers and by the co-leader at a meeting of the D. C. Home Economics Association, Health and Welfare Section.

Plans: Work will continue at approximately the same level. Reports now in preparation will be completed after which laboratory work will be resumed to determine the energy expenditures of women performing additional household operation, for example, while cleaning rugs and carpets with different types of vacuum cleaners, or while using different types of household laundry equipment.

Publication: Energy expenditures of women performing selected activities. M. Richardson and E. C. McCracken. Home Econ. Res. Report No. 11 (in press).

B. RURAL HOUSING REQUIREMENTS AND INTERIOR DESIGN

CH

Problem: More extensive research is needed on the space requirements for work and storage areas involved in household activities, and designs should be developed for working and living areas in functional farm houses that will meet the needs of families in different stages of the family cycle.

Program: Laboratory studies of two to four years duration for each phase have been carried on at Beltsville, Maryland, as part of the inter-regional housing research program developed and conducted with state Agricultural Experiment Stations in all parts of the country. Approximately three professional federal man-years annually are devoted to this work.

Progress:

1. Household activity areas. Data obtained in an interregional study of dimensions of space needed around household equipment and furnishings are being interpreted in terms of standards for household activity areas. This involves establishing criteria for adequacy of space in an activity area, based on principles of good management of time and effort; devising formulae for calculating space standards that meet the criteria; and finally, applying laboratory data to the formulae to develop specific space recommendations. To date, tentative recommendations have been developed for sleeping, dining and home business areas equipped with various combinations of furnishings and equipment in different arrangements. A paper presenting results of recent research on space requirements was presented at a meeting of the American Society of Agricultural Engineers in Columbus, Ohio, June 15, 1960.
2. Energy-saving kitchen designs. A third energy-saving kitchen has been developed around kitchen cabinets of unique design, based on findings from the Division's research on human energy expenditures and from state and federal research on space requirements for household activity and storage areas. Laboratory tests of the kitchen in three arrangements were completed and data are being prepared for inclusion in a series of technical articles.

Although designed with the millions of aged and handicapped homemakers in mind, the energy-saving kitchen designs have won wide acceptance for able-bodied homemakers as well, as evidenced by the interest of visitors to the exhibits at the Agricultural Research Center, the demand for departmental publications describing the kitchens, and the volume of publicity given by magazines and newspapers to each design. Since 1956 when an exhibit of the first energy-saving kitchen was installed at the Research Center, about 18,000 visitors, foreign and domestic, have visited the kitchen exhibit. Research workers served in consultative capacity to journalists from magazines reaching different publics, among them Agricultural Research, Farm Journal, Successful Farming, and House Beautiful. Each magazine has carried feature stories as have numerous newspapers and Sunday magazine supplements.

At the invitation of the Virginia Rural Electrical Cooperative, a paper on research in kitchen planning was presented at a meeting in Roanoke in May 1960. A similar presentation was made at the 43rd annual meeting of the American Dietetic Association in Cleveland, Ohio, October 1960.

Plans: Emphasis will be placed on evaluation of results and preparation of technical and popular reports of research on the three energy-saving kitchens and on space requirements for household activity areas.

Publication: Beltsville energy-saving kitchen, Design No. 2. Leaflet 463, 4 pp., illus. November 1959.

C. FARMSTEAD WATER SUPPLY AND WASTES DISPOSAL

AE, CH

Problem: Greater use of water-connected equipment and higher standards of sanitation on many farmsteads are creating demand for more potable water than can be had from existing wells and are creating more water-carried wastes than can be disposed of satisfactorily.

Program: This is a continuing, long-range program of applied research on the water requirements of the modern farmstead, both farmhouse and service areas. Current work in cooperation with the University of Maryland involves about one professional federal man-year annually.

No formal program is in progress on disposal of farmstead wastes other than continuing office review of current developments in the field and liaison with other research agencies.

Progress:

1. Water requirements. Equipment for automatically metering and recording the use of water for specific purposes in the farmhouse and on the farm has been developed and tested in the laboratory. Meters have been installed at the well, in the house, and in the milkroom on a farm near Frederick, Maryland, and are being read weekly to obtain preliminary, survey-type information. A schedule form is being developed for use in case studies of family practices in household usage of water.
2. Wastes disposal. A manuscript is being prepared for major revision of Farmers' Bulletin No. 1950, "Sewage and garbage disposal on the farm." Several "lagoons" or "stabilization ponds" for disposal of livestock manure were observed in the Midwest to obtain preliminary information on their design and effectiveness to serve as the basis for formulating a research project on this subject. Although use of this type of facility would be limited, it shows promise of successful application in relatively remote locations.

Plans: Work on the water requirements phase of the study will be expanded with initiation of a pilot study on patterns of household use of water as determined through interviews with selected homemakers in rural areas accessible from Beltsville, Maryland. Metering will be continued to obtain water usage data on operations at the University of Maryland dairy farm and on a dairy farm near Frederick, Maryland. When funds are available, additional meters and automatic recording equipment will be installed to obtain more comprehensive data of farmhouse and service operations.

Major revision of Farmers' Bulletin No. 1978, "Safe water for the farm," will be initiated.

Experimental lagoons for disposal of manure from swine and poultry will be installed and observed in Maryland.

D. PLANNING GUIDES AND FARMHOUSE PLANS

CH, AE

Problem: Results of research on requirements for functional housing should be translated into standards that can be published in form readily usable by architects, other professional designers, and farm families. House plans should be developed for the Regional Plan Service that incorporate these standards as well as the results of research on building materials and construction methods.

Program: A continuing activity at Beltsville of CH and AE involves the development of graphic presentations of housing requirements and preparation of other housing guides and the development of farmhouse plans that incorporate new and existing research results on space standards, interior design, building materials, and construction methods. This work is done in cooperation with state Land Grant colleges through regional housing programs. About five professional federal man-years annually are involved.

Progress:

1. Farmhouse plans for the Regional Plan Service. This architectural service to farm families is carried on cooperatively by the CH and AE Research Divisions of ARS, the Federal Extension Service, and the state agricultural colleges. CH is primarily responsible for the development of the functional design of interior areas of the house and for seeing that the results of research on space requirements, efficient arrangements of space and equipment, and other functional requirements are incorporated. AE is responsible for the development of the architectural features and construction drawings, and for the preparation of the notification leaflets of house plans.

In 1959-60, plans and detailed working drawings were completed for four new house plans which range in size from one to three bedrooms. Two of these houses were designed around the second energy-saving kitchen In addition, four plans that have been in the Plan Exchange for a number of years were revised to incorporate the results of recent research on space requirements. These eight new and revised plans have been made available to farm families either through the state Agricultural Engineer or through the key state for the Regional Plan Exchange of each region. Three other 2- and 3-bedroom house plans currently carried by the Western Plan Exchange are in the process of revision.

Special attention has been given during the year to increasing the use of the house plans through better publicity and faster distribution of plans and information concerning them. The series of miscellaneous publications on individual house plans, which was initiated during Fiscal Year 1958 to take the place of regional catalogs, appears to be accomplishing the objective of providing farm families with information about new house plans soon after

they become available. Miscellaneous publications describing three of the new and two of the revised house plans have been prepared during the year and are now in press. Each publication describes the functional aspects and special construction features of one of the house plans and is illustrated with a plan and a perspective of the interior and exterior, as well as a suggested plot plan. To further speed distribution to farm families, drawings of new plans are being sent to states in transparency form from which reproductions can be made. A publicity program on house designs developed for the Plan Exchange Service was initiated during the year. Representatives from USDA extension research and information groups met and proposed that a mailing list of real estate editors be established to whom press releases could be sent. To date there are 60 editors on this list and releases on houses have been submitted to them as follows:

Brick rambler. New USDA farmhouse plan designed around energy-saving kitchen. June 22, 1960.

Compact cottage. New USDA plan features comfort, efficiency, economy. May 11, 1960.

Flexible houseplan. New USDA farmhouse features research-developed kitchen. March 30, 1960.

2. Expansible farmhouses. A final evaluation was made of five expansible farmhouses designed by the two Divisions and built at the Agricultural Research Center during the 1950's to house dairy workers and their families. From the engineering standpoint, variations from conventional construction methods and materials generally produced satisfactory results at lower cost. The case-study families, however, preferred the more conventional frame structure with wood floor, double-hung sash, and no glass at floor level.

An experimental feature of one house -- grade beam foundation -- proved satisfactory and has recently been incorporated in the Minimum Property Standards of the Federal Housing Administration. Asbestos cement board and corrugated aluminum, used for the exterior of two houses, remained attractive, weathered well, and required no painting. Fiberboard roof sheathing proved effective as insulation, and attractive as the interior ceiling finish of one house. The use of perimeter ducts of heavy paper with forced warm air systems which has increased in recent years, proved completely satisfactory in the house in which it was installed. One house was constructed of SCR brick developed by the Structural Clay Products Research Institute; as an experimental feature, walls in the living room and bedrooms were not furred. These interior surfaces proved to be damp and cold during winter and rainy periods. They will eventually be furred and an interior finish applied as originally recommended by the brick manufacturer.

The kitchens rated high in the opinion of the residents. Working and storage space met and, in several instances, exceeded the new standards for limited space. Occupants generally were pleased with the arrangement, location, and size of the kitchens. The cost-cutting device of omitting cabinet doors met with disfavor; the five homemakers wanted doors on wall cabinets to keep shelves cleaner and the kitchen neater. The location of dining areas in relation to the living room, particularly when there is space for only one dining area, was very important to the case-study families. All preferred the dining and living areas separated; the dining-kitchen combination in two of the houses was not objectionable. With one exception, the dining areas met the present minimum standard for space. Storage space for clothing was inadequate in four houses as evaluated by current space standards; opinions of three of the four homemakers verified this finding. Although space for household textiles exceeded the minimum standard in four houses, all homemakers expressed a need for larger or more convenient storage space for bedding or table linens or both. Utility areas in these basementless houses were inadequate by present-day space standards and in the opinion of the case-study families. More storage space was needed for cleaning, laundry, and home maintenance tools and supplies, reserve foods, chore and play clothes, equipment and furniture used for out-of-door living activities. All families wanted a freezer; in only two houses was there space for one. Nor was there space for the automatic laundry equipment that families desired.

The deficiencies in livability found in these Beltsville farmhouses point up problems encountered in designing minimum-cost housing that adapts readily to changing patterns of living that are brought about by new types of equipment, new methods of work, and progressively higher standards of living.

Two reports have been prepared for publication in the ARS processed series. One reports the above findings, the other the relationship of the structural design features to the heat requirements. Information on finishing materials for floors and counters compiled for a revision of a guide for planning bathrooms was used in a talk given before USDA's 37th Annual Outlook Conference, November 1959.

Plans: Development of new and revised farmhouse plans and the preparation of research-based planning guides will continue at about the same level. With the publication of the report on the evaluation of five experimental farmhouses, work on these houses will be discontinued. Upon completion of a revision now under way of HG-19, Planning the bathroom, revision of HG-12, Planning the kitchen and workroom, will be initiated. If time permits, work will start on the review of other bulletins in the "Your Farm House" series to incorporate the results of recent research.

Publications:

1. 3-bedroom farmhouse with two full baths. Cooperative Farm Building Plan No. 7136. USDA Misc. Pub. No. 812, 2 pp., illus. February 1960.
 2. Farm cottage. Cooperative Farm Building Plan No. 7137. USDA Misc. Pub. 795, 2 pp., illus. July 1959.
 3. 1-bedroom farmhouse with flexible living features. Cooperative Farm Building Plan No. 7146. Misc. Pub. in press.
 4. 2-bedroom farmhouse. Cooperative Farm Building Plan No. 7158. Misc. Pub. in press.
 5. Floor coverings and counter tops. Mildred S. Howard. Real Estate News: pp. 411-413, December 1959; pp. 20-22, January 1960.
- E. OPERATING CHARACTERISTICS, PERFORMANCE REQUIREMENTS AND USE OF MODERN HOUSEHOLD EQUIPMENT CH

Problem: Unbiased information is needed by homemakers on the operating characteristics of household equipment of different designs, and by manufacturers on the performance required to meet homemakers' needs. Furthermore, specifications are needed by the several federal agencies which purchase household equipment, and test procedures basic to these specifications are needed for inclusion in American Standards.

Program: A continuing laboratory program is directed toward the establishment of performance requirements for various types of household equipment and the determination of efficient methods of equipment use. Industry cooperates by furnishing the equipment studied. Upon request, results of research and information available from other sources are incorporated into purchase specifications and testing procedures, in cooperation with the Federal Specifications Board and the American Standards Association. About five professional federal man-years annually are involved.

Progress:

1. Time-temperature patterns of household refrigerators. As part of a concerted attack being made by government and industry on problems of maintaining quality in frozen foods, determinations have been made of the time-temperature patterns and mechanical operating characteristics of representative household refrigerators. Data have been summarized and evaluated, and a technical manuscript is being prepared for publication. A confidential report on the results obtained with each refrigerator has been prepared and sent to the manufacturer. A preliminary report was presented at USDA's 37th Annual Outlook Conference, November 1959.

2. Use of mechanical washers and dryers. To provide a basis for recommending home laundering methods which will save time and work, and make effective use of available equipment, research has continued on laundering present-day fabrics. Studies concerned primarily with wrinkling, in which unsoiled swatches were used, were reported in 1958. Highlights were presented at USDA's 37th Annual Outlook Conference in November 1959, and a journal article has been cleared for publication.

Studies of soil removal have now been completed. For this purpose white fabrics previously used in the study of unsoiled swatches were made into blouses (7 cottons with special easy-care finishes, 2 Dacrons, 1 nylon, and 3 blends) and worn by volunteers working at the Agricultural Research Center. Soiled blouses were returned to the laboratory at the end of each week, with an average wear time of about 12 hours.

Since a 140° F. washing temperature resulted in significantly more wrinkling of the swatches than 100° F. or 60° F., research was conducted to test whether the two lower temperatures, while minimizing the need for ironing garments made from the fabrics, would adequately remove soil.

The experimental design provided for one soiled blouse of each fabric in each washer load. Washing procedures were the same for all loads except for two water temperatures, 100° F. and 60° F., and two household detergents - one containing a built soap and the other a syndet. Since in the swatch study a drying temperature of 150° F. tended to give less wrinkling than 120° F. and 180° F., gas and electric tumble dryers were used at 150° F. Rack drying at room temperature was also included. In a continuing search for better methods of evaluating fabric properties and the effects of wear and laundering, attention was given to the agreement between subjective evaluations of the appearance of the blouses and laboratory measurements of color (Color Difference Meter) and of wrinkling (Wrinklemeter).

Comparison of the original fabric color with that after the 17th (last) laundering indicated that generally the two washing temperatures were equally satisfactory for soil removal, as measured by greyness and yellowness, and by whiteness factors calculated from these values according to a formula developed by the designer of the Color Difference Meter on the basis of data from previous research in this laboratory. The amount of oily residue extracted from some of the garments after the 17th washing period supported this conclusion. The soap used was more effective than the syndet in removing soil from the fabrics as shown by measurements of greyness, whiteness factors, and oily residues. Fluorescent whiteners included in both household detergents tended to mask yellowness, the synthetic detergent giving slightly better results than the soap, probably because the whitener it contained produced more fluorescence than the one present in the soap. (An intensive study of fluorescent whiteners now under way is mentioned under Textiles and Clothing, VI-B-2.)

Drying methods were not different in their effect from the standpoint of greyness, but more yellowing and therefore lower whiteness factors generally resulted when gas rather than electric tumble-drying or rack drying were employed. Higher amounts of oily residue were extracted after gas and electric tumble-drying than after rack-drying, perhaps because the heating of the fabrics as they were tumble-dried rendered any remaining soil less soluble and permitted a build-up of oily residues in subsequent washes. Notwithstanding the above-noted differences in color and residual soil as measured by laboratory means, all blouses were judged by the cooperators to be clean enough to wear to work. Satisfactory cleanliness from this subjective standpoint was maintained throughout the 17 wash-wear periods.

Subjective ratings showed a trend for less wrinkling in blouses laundered in 60° F. water than in those laundered in 100° F. water. Tumble-dried blouses were generally rated by a judging panel as being less wrinkled than those dried on racks. Cotton blouses were usually judged as requiring ironing regardless of whether tumbled or rack-dried. After tumble-drying, most of the fabrics of manmade fibers, or blends, were rated as satisfactory without ironing. No consistent pattern as to need for ironing was evident after rack-drying.

Use of the wrinklemeter, which had been developed by the Hunter Laboratories at the suggestion of CH for the earlier study on swatches, was further explored in an attempt to relate instrument measurements with subjective ratings. The designer of the wrinklemeter modified it slightly and provided a second method of standardization which increased flexibility of use. Instead of comparing instrument readings directly with scores, a formula for interpreting these readings as wrinklefactors was developed in this Laboratory. Wrinklefactors of laundered samples of the fabrics used in the blouses correlated well (-0.83) with judges' scores of wrinkling in the laundered blouses. A preliminary report of the results on this second phase was given in March 1960 at the Southern Experiment Station Collaborators' meeting at SURRD. A manuscript is now being cleared for publication.

Collaborative work with the Wash-Wear Committee of AATCC was conducted as part of an interlaboratory test of two lighting methods and two sets of standards for panel evaluation of wrinkling. One of the project leaders was active in the Washington Section's group which participated in the 1959 Intersectional Contest sponsored by the American Association of Textile Chemists and Colorists.

3. Performance and space requirements for small appliances. Research was initiated to determine the space required to use and store automatic cooking appliances and to evaluate their cooking performance in comparison with the conventional range. This work was proposed by the Home Economics Research Advisory Committee and appears to be of considerable importance as judged by the many inquiries received from homemakers, manufacturers, extension workers and teachers. Industry cooperation in the consignment of equipment has been excellent. Statistical designs for the study have been developed with the assistance of the Biometrics Services staff and preliminary investigations have begun.

4. Specifications for testing and purchase of household equipment. The Laboratory continued its participation and, in some instances, took active leadership in committee work involved in the following:

Federal Specifications:

- (a) W-H-196, Heaters, Electric: Water, Storage, Domestic: Revision of specifications was completed and issued as a U. S. Department of Agriculture Interim Specification.
- (b) W-R-101, Ranges, Electric: Domestic, Cabinet-type: Preparation of revision has continued.

American Standards:

- (a) C70.1 Household Automatic Electric Flatiron: Comments on second draft incorporated in third draft. Circulation of third draft is being postponed until an acceptable leakage-current test can be agreed upon by the Committee.
- (b) C70.2 Electrically Heated Bed Coverings: Committee's comments on first draft were received and are being incorporated into second draft.
- (c) C70.4 Waffle Bakers and Sandwich Grills: Second draft of a revision, incorporating comments of Committee, was completed. Draft being held pending Committee's acceptance of a leakage-current test.

Z21 Sectional Committee, American Gas Association Approval Requirements:

- (a) Z21.1 Subcommittee on Domestic Gas Ranges: Reviewed proposed revision of a standard which became effective January 1960, and assisted in the preparation of a new draft.
- (b) Z21.19 Subcommittee on Refrigerators Using Gas Fuel: First draft of a proposed revision circulated by AGA was reviewed and assistance was given in preparation of the second draft which has been circulated for industry comments.

Chairmanship was accepted for a U. S. Subcommittee on "Construction and Testing of Household Refrigerators" under ISO/TC-86, a project of the International Organization for Standardization on "Coordination and Development of Standards in the Field of Refrigeration." The first draft of a proposed standard which was furnished by the French Secretariat was circulated to U. S. A. Subcommittee members. Their comments have been correlated and forwarded to the Secretariat's office in Paris.

Plans: Work will continue at approximately the same level. Technical and popular reports on the time-temperature patterns in household refrigerators, and the use of mechanical washers and dryers in laundering present-day fabrics, will be completed. Laboratory work will continue to determine (1) temperatures needed in hand irons for care of present-day fabrics, and (2) space requirements and operating characteristics of portable automatic cooking equipment. Plans will be developed for research on other equipment problems, probably related to dishwashers and/or combination washer-dryers. Specifications now being developed will be completed and work on additional items will be prepared upon request by the Federal Specifications Board of the American Standards Association.

Publications:

1. Wash and wear ratings: Subjective and objective. (1959 Intersectional Contest Paper, Washington Section, AATCC. N. Poole and other AATCC Committee members.) American Dyestuff Reprtr. 48 (21): 57-62. October 19, 1959.
2. A survey of household refrigerators. Earl C McCracken. Real Estate News: pp. 54-58, Feb.-Mar. 1960.

VIII. FAMILY ECONOMICS

A. FAMILY LIVING STUDIES

HHE

Problem: Information on expenditures for living and quantities of goods and services purchased or otherwise procured by rural households is needed to appraise levels of living and to facilitate programs of the Department and other agencies concerned with raising standards of living.

Program: Nationwide surveys of rural families at 8-10 year intervals with samples large enough to permit statistical analysis for various population groups supplemented, as appropriate, by small-scale special-purpose surveys to provide information relating to specific questions and programs such as rural development. Work involves about 5 professional federal man years annually.

Progress:

1. Farm Family Spending in the United States. Consultations within the Department and with staff of the Bureau of Labor Statistics have been continued regarding plans for a nationwide rural family income and expenditure survey to be coordinated with the BLS survey of urban families planned for 1961 and 1962.

Plans: Consultations and advance planning will be continued so that if a rural survey is approved for fiscal year 1962, the surveys of the two Departments can be added together to obtain data for the United States as a whole.

2. Research Studies for the Rural Development Program. Surveys of family living have been made in selected areas of Georgia, Kentucky, Texas, and Ohio to provide information that will be useful to personnel engaged in the Rural Development Program as well as to others associated with programs designed to improve levels of living.

Studies made in Georgia and Ohio were designed to determine how much of the gross earnings of employed women whose husbands are employed full time are available for family use after deducting various job-related expenses including higher income taxes occasioned by the wife's earnings, and what changes are likely to occur in management practices in the home as a result of her employment. In order to determine differences in household management practices and in certain expenditures common to both employed and nonemployed wives, data were obtained from both groups. The Georgia survey was limited to residents in four small cities. In the Ohio study information was obtained from both rural and city families so that differences in job-related expenses and home management practices of rural and urban employed wives can be determined.

The family living surveys in selected counties in Kentucky and Texas were designed to evaluate the levels of living of families residing in the open country and to provide a comparison of the level of living attained by families engaged in full-time farming and families engaged

in full-time farming and families engaged in part-time farming or supported entirely from nonfarm sources. The first two surveys were conducted in Rural Development areas--one in South Central Kentucky relating to 1956-57, and the second in East Texas covering the year 1958. The third, covering selected counties in the Northern Blackland area of Texas, was designed to provide, in addition to the types of information listed above, an insight into how rural families adjust to the introduction of industry into an area which had been predominantly agricultural. Data from the third survey relate to the year 1959.

In the Kentucky and Texas surveys the traditional evaluation of the family's level of living on the basis of expenditures and limited data on home production is being expanded to include a fuller evaluation of consumption. Estimates of the annual use value of such durable goods as housing, furnishings, vehicles and clothing are added to expenditures for nondurable goods and services, the value of home-produced food and fuel, and the value of goods and services received as gift or pay to provide the value of consumption.

In the Texas surveys photographs of the houses were taken and these, along with information on facilities and construction of the dwelling, were used in estimating the annual use value of the structures. The Extension Engineer at the Experiment Station at College Station reviewed the grade of construction and state of repair of the dwelling assigned by the field interviewer.

An analysis of the population surveyed in the selected Rural Development areas of South Central Kentucky and East Texas indicates that an outstanding characteristic of these areas is the loss of young adults from their population. The educational level in these areas is relatively low--both the family heads and their wives had had less schooling than the national average for the rural population 25 years of age or older. Although both areas were predominantly rural, the Texas area had within it one city of approximately 40,000 population and in each county at least one town that meets the Census definition of an urban place. On the other hand, the Kentucky area had only one urban place and its population is only about 7,000.

Largely because of the greater opportunities for off-farm employment that go along with towns, fewer of the Texas families were completely dependent on farming and a larger proportion obtained all their income from nonfarm sources than was the case with the Kentucky families. In the Kentucky area, 78 percent of the families were at least partly dependent on agriculture and 55 percent obtained most or all of their income from farming. On the other hand, 49 percent of the families in the Texas counties surveyed had no income from farming and an additional 40 percent received more of their income from other sources than from farming. Only 11 percent were dependent on farming as their principal source of income.

The greater importance of nonfarm income in the Texas area raised the

income there considerably above the level in Kentucky, indicating the value to an area of developing diversification in sources of income.

A special analysis was made of the spending patterns of families with net incomes under \$2,500 included in the Kentucky and East Texas Surveys. This analysis showed, as did data from the nationwide 1955 survey, the very heavy medical expenses borne by the elderly. In Kentucky, families with heads 70 years of age and older spent appreciably more for medical care than did families whose heads were between 30 and 49 years of age--\$235 versus \$180--although families in the latter group average nearly twice as many persons. The East Texas families had appreciably higher per person food expenditures than did the Kentucky families; however, when the value of home-produced food and changes in retail prices of food between the dates of the surveys are taken into consideration, there appears to be little difference in the money value of food used by these two groups.

For the Kentucky sample as a whole, the value of consumption was estimated to be almost half again as large as expenditures. Among the commodities, greatest differences occurred in food, in which category the value of consumption is double expenditures, largely because of home production. The consumption value of shelter exceeded expenditures by 66 percent. The fact that expenditures for taxes and mortgage interest are carried as a farm expense explains a large part of this difference, but home production of fuel also contributes to it. Expenditures for furnishings and equipment, another component of shelter, were greater than consumption, indicating that these families were building up their stocks of furnishings and equipment. Clothing consumption exceeded expenditures by 44 percent. Home sewing and gift clothing account for the difference. For all other categories combined, expenditures slightly exceeded consumption.

The value of consumption increased proportionately less than did expenditures with an increase in income, family size or the educational attainment of the head. The value of consumption fell off less than did expenditures with increase in the age of the head. The value of all consumption was about \$1,000 higher than expenditures for family living for those families wholly or partly dependent on farming but only about \$400 greater among families dependent on nonfarm income.

A statement describing some of the findings from the Division's family economic studies that have implications for the Rural Development Program was presented at a meeting of the Department's Rural Development Committee. It is expected that this information will lead to a strengthening of programs designed to improve levels of living in low-income areas.

Plans: The Georgia study will be published as a USDA bulletin. The Ohio study, field work for which was not completed until late July 1960, will be processed and analyzed and a manuscript started. Some data from this survey on off-farm employment of husbands and wives in the rural area will be used in a talk at the Agricultural Outlook Conference.

The feasibility of conducting a survey of job-related expenditures or working wives under contract arrangements will be investigated.

The Kentucky study will be published as a bulletin. Emphasis will be on the family living of the families in these 5 low-income counties as depicted by the money value of their consumption.

Tabulation and analysis of the data for the East Texas study made in 1959 will be completed and a manuscript started.

Analyses of the income changes experienced by a portion of the East Texas families between 1955 and 1958 and the effect of these changes on their 1958 expenditures will be made for the Agricultural Outlook Conferences.

B. FAMILY FINANCIAL MANAGEMENT AND ECONOMIC PROBLEMS

HHE

Problem: Information on money and time management, on the manner in which families adjust their living to changes in resources, and on other economic problems of families is needed to develop source material for consumer education and information on the current family-living situation and outlook.

Program: Studies of money and time management and investigation into the manner in which families adjust their living to changes in family situations are made from time to time. The results of these and other studies of economic problems of families are assembled in a quarterly publication, interpreted annually at the Agricultural Outlook Conferences, and used in materials prepared for guiding family spending. About 5 professional federal man years are required annually.

Progress:

1. Replacement Rates for Household Durable Goods. The fourth in the series of nationwide surveys to determine the average length of time that selected items of household durable goods are used by one owner under current conditions of usage was made in May 1960. This survey, as well as the three earlier ones, was conducted by the Bureau of the Census in conjunction with its monthly Current Population Survey.

Estimates of service life expectancy derived from these surveys are useful to families in their financial planning, and to home economists and other professional workers in estimating the value of household goods held by farm families. Data from this project have been republished in several magazines and newspapers, for example, in the New York Times and U. S. News and World Report.

The first survey covered electric refrigerators, electric washing machines, and gas and electric ranges. Each subsequent collection has repeated one of these items in order that changes in replacement rates may be studied, and has obtained data on additional items. The additional items investigated to date are vacuum cleaners, sewing machines, toasters, living room rugs, and TV sets.

The first two surveys provided data for analyzing the consistency of reports on household durables obtained from the same households in surveys about a year apart. The ability of the households to report accurately the age of the various items of household durable goods included in the surveys is basic to the success of the actuarial method used in this project to estimate the life expectancy of durables under one owner. Consistency in data reported at different times would not prove their accuracy, but inconsistency would indicate inaccuracy in at least one of the paired responses and would render the method suspect. The data used in this analysis consisted of reports by 2,089 households on the year of acquisition, the type (automatic, semiautomatic, and wringer or spindryer), and condition at time of purchase (new or used) of washing machines owned at the time of the survey and those discarded during the previous 12 months. Comparisons of the responses from the two interviews were made on each of the three points.

Although only 29 percent of the paired reports were consistent on all three points, the amount and degree of inconsistency found do not discredit the use of the method. Greatest differences occurred in the reporting of the year of acquisition. Only 33 percent agreed exactly but almost half of those in disagreement differed by only 1 year.

There was a correlation coefficient of 0.81 for the two sets of responses and such differences as occurred tended to cancel out within the group. Consistent reports on condition at time of purchase were made by 93 percent of the households. Indications are that some respondents failed to understand the term "semiautomatic" with the result that 12 percent of the paired responses on type of machine were in disagreement.

An article entitled "An Analysis of Consistency of Response in Household Surveys" has been approved for publication and has been submitted to a technical journal.

Plans: Life expectancy estimates for TV sets and electric refrigerators will be computed from data collected in the May 1960 survey. It is hoped that the fifth in this series of surveys can be conducted late in the coming year. After that collection, there should be a sufficient body of data to permit the careful evaluation of the use of the actuarial method in estimating the life expectancy of certain household durables, including some findings as to cyclical variation. It is recognized, however, that the method is not suitable for those items owned in quantity on which age reports cannot be obtained individually. The method also presents operational difficulties if data are collected through another agency, and the volume of data needed makes this procedure undesirable. Attention should therefore be focused on developing or improving other methods of estimating replacement rates. Two methods that should be explored further are inventory-acquisition ratios and the distribution of the dates of last purchase.

2. Development of Rural Family Living and Outlook Reports. Four issues of Family Economics Review were released during the year as a part of a continuing service to home economists and others interested in economic

problems of families. Over 6,000 copies of each issue were distributed. Many complimentary expressions on the content of Family Economics Review and of appreciation of the need it meets continue to be received.

The December issue consisted of some of the speeches presented at the Annual Agricultural Outlook Conference that covered topics of especial interest to home demonstration agents, State home economics specialists, and college and university teachers of home economics. Articles prepared for the other issues that are not reported in other work projects were:

Income of Orphans and Their Widowed Mothers
Incomes of Families and Number of Earners (1958)
Calculating Installment Credit Costs
Changes in Fiber Consumption
Improvements in Education Noted
The 1959 Census of Agriculture
Family Living Expenditures of Low-income Farm Families
Factors Affecting the Employment of Women
Trends in the Consumer Price Index for Housing During the 1950's
College Plans of Students
Changes in Employment of Teachers in Public Schools, 1957-1958

A questionnaire was sent with the March issue to a sample of readers of Family Economics Review. The purpose was to determine the subject matter interests of the readers and the uses they make of the material. The questionnaire was sent to a sample of about 16 percent of those on the mailing list; approximately 35 percent of the questionnaires were filled in and returned. The replies have been tabulated and this information will serve as a guide in selecting content for future issues.

Contributions to the Annual Outlook Conference included preparation of 12 charts for the section entitled "Family Living Improves in 1950's" of the Chartbook and preparation of parts of the paper on Agricultural Outlook for 1960 presented at the general session.

One session on the topic "Consumer Credit" was planned for home management specialists attending the Conference. Two papers were presented by staff members: "Patterns of Use of Consumer Installment Credit" and "Why Installment Credit Costs Vary." The staff of a Subcommittee of the Senate Committee on Banking and Currency requested copies of these papers at the time they were preparing for hearings on the Consumer Credit Labeling Bill (S. 2755). A senior staff member of that subcommittee congratulated the Branch on the quality of these papers and stated the subcommittee had found them very useful in their work and the best presentation of such material for the general public they had seen. Much of the information was used in an article which appeared in Changing Times.

A member of the staff contributed to a chapter for the 1961 Yearbook of Agriculture. The chapter was entitled "Farm Homes Share in the (Technological) Revolution."

A draft of a completely rewritten version of "Guiding Family Spending" has been completed and is being reviewed within the Division. This bulletin is intended for the use of Extension personnel, public welfare workers, and others who counsel families in money management.

Plans: Quarterly publication of Family Economics Review will be continued. The feasibility of getting Budget Bureau clearance so that it can have wider distribution will be investigated. The Division will participate in the planning for the Annual Agricultural Outlook Conference and will be responsible for two sessions for home management specialists attending the Conference. These two sessions will be centered around the economic problems of low-income rural families. Review of the draft of "Guiding Family Spending" will be completed, and the revised draft will be presented for approval for publication.

Publications: Part VIII FAMILY ECONOMICS

Section A - Family Living Studies

1. Estimates of Value of Household Inventories on Farms, included in the Balance Sheet of Agriculture, Agriculture Information Bulletin No. 214, October 1959.

2. Two tables in Agricultural Statistics, 1959:

Rural family living: Expenditures for family living and value of consumption in a rural development area, Kentucky, 1956-57.

3. Spending for family living: Average expenditures for selected items by account-keeping families in two States, 1944-58.
4. Family Living Expenditures Among Low-Income Rural Families. Laura Mae Webb. Proceedings of Agricultural Economics and Rural Sociology Section of Southern Agricultural Workers, 1960.
5. Studies Contribute to Rural Development Program, Family Economics Review, September 1959.

Section B - Family Financial Management and Economic Problems

1. Family Economics Review, September 1959, 29 pp.; December 1959, 27 pp.; March 1960, 26 pp.; June 1960, 24 pp.
2. Twelve charts in Agricultural Outlook Charts '60, published by Agricultural Marketing and Agricultural Research Services, November 1959.
3. Patterns of Use of Consumer Installment Credit. Emma G. Holmes; and Why Installment Credit Costs Vary. Minnie Belle McIntosh. (Two papers at the November 1959 Outlook Conference)

4. Consumer Installment Credit--Patterns of Use and Cost. Emma G. Holmes and Minnie Belle McIntosh. Journal of Home Economics, February 1960.

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